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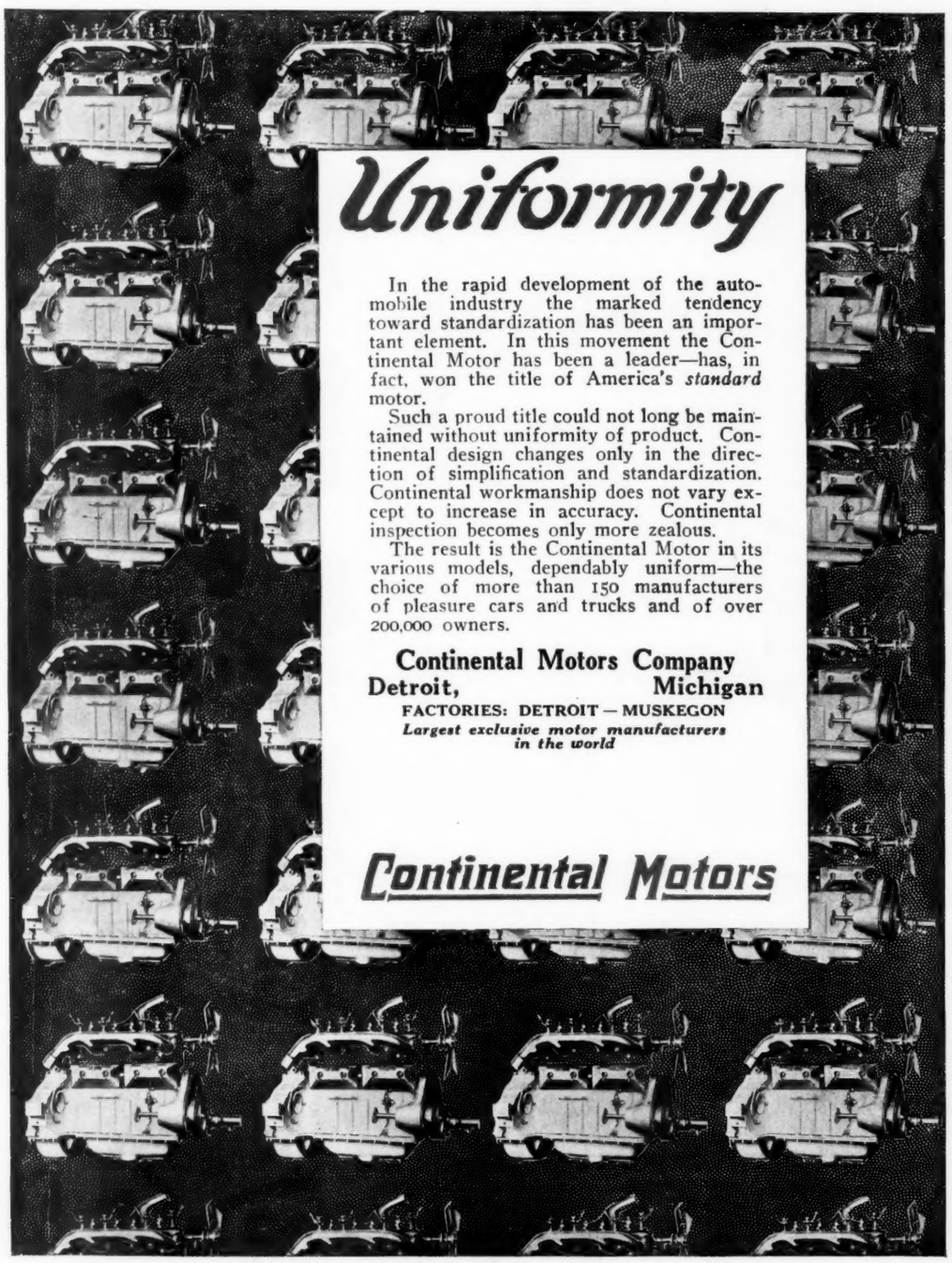
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VOL. XXXIV NEW YORK—THURSDAY, JUNE 1, 1916—CHICAGO No. 22

The AUTOMOBILE

Resta Wins Sweepstakes

His Peugeot Covers 300-Mile Course on Indianapolis Speedway at 83.26 M.P.H. —D'Alene's Duesenberg Second at 83.15

Mulford's Peugeot Third and Christiaens' Sunbeam Is Fourth — Two Accidents

By J. Edward Schipper

DARIO RESTA, a native of Sunny Italy, and a citizen of the United States, flashes once more to the fore. To-day he added another jewel to his crown of speed by winning the 300-mile Indianapolis classic with his Peugeot. D'Alene, a Californian, driving a Duesenberg, took second place.

Resta's time was not as fast as that for the same distance of a year ago, when the race was 500 miles long, his average being 83.26 m.p.h. In 1915 Resta covered the distance at a speed of over 89 m.p.h.

Two accidents marred the afternoon. Tom Rooney, whose car blew a shoe on the back stretch, had his shoulder dislocated and his hip broken when his car rolled over. His mechanic, Jim McAllister, was badly bruised. Jack LeCain was injured more seriously when he also struck the retaining wall on the back stretch and sustained severe injuries. It is feared that his back may possibly be broken.

Good Generalship

The driving of Resta will be long remembered for the cool calculation displayed. He let the leaders who dashed to the front in the first few laps set the pace and then, when accidents had put them out, he continued to set a safe pace which was just sufficient to carry him across the finishing line by a little over 2 min. ahead of D'Alene. Resta only stopped once, when he changed his rear tires and put in gasoline and oil, the total time for this stop being 1 min. and 5 sec. It occurred in his sixth-ninth lap, and the time lost did not interfere with his lead.

Ten Cash Prizes

This year's purse includes ten positions. It totals $30,000 with $12,000 for first, $6,000 for second, $3,000 for third, fourth $2,000, fifth $1,700, sixth $1,400, seventh $1,200, eighth $1,000, ninth $900 and tenth $800.

At 12.30 the cars were lined up across the track in the order of start, which had been determined by the speeds made in the elimination trials. They were then sent around the track one at a time, while announcers introduced them to the crowd. After again getting into position the cars were paced a lap, led by Frank Smith in a white Premier, started and crossed the line for the beginning of the race almost on the tick of 1.30.

Around they circled, and almost immediately the parade of cars which had been four abreast began to string out in a line, so that, at the end of the first lap, the entire ellipse was doted with the flying speed creations.

Across the line they sped, with the cars that were to set the pace already in

THE WINNERS

Car	Driver	Time	M.P.H.	Prize
Peugeot	Resta	3:34:17	83.26	$12,000
Duesenberg	D'Alene	3:36:15	83.15	6,000
Peugeot	Mulford	3:37:56	82.6	3,000
Sunbeam	Christiaens	3:46:36	79.96	2,000
Delage	Oldfield	3:47:19	79.2	1,700
Maxwell	Henderson*	3:49:56	78.3	1,400
Premier	Wilcox	3:54:31	76.8	1,200
Crawford	Johnson	4:01:54	74.4	1,000
Crawford	Chandler	4:02:43	74.2	900
Osteweg	Haibe	4:03:10	74.0	800

*Rickenbacher driving at finish.

the lead. Eddie Rickenbacher in his Maxwell came first, followed by Aitken in a Peugeot and Resta in another Peugeot. Close behind came Anderson in a Premier, Rooney, his team-mate, in another, Merz in a Peugeot, Wilcox in another Premier, Arthur Chevrolet in a Frontenac and a scattered field trailing along behind.

Rickenbacher Leads

The second lap saw Rickenbacher opening a gap between himself and his pursuers. About 300 yards separated him from the nearer cars, foremost among whom were Aitken and Resta. The same order prevailed among the others except that Arthur Chevrolet had pulled up and was now in seventh place with his Frontenac. Merz was driving his Peugeot at a tremendous pace to force himself up among the leaders and was gradually gaining. At the end of the fifth lap Rickenbacher, who had now gained a lead of 1000 yd., lapped Johnson in his Crawford just in front of the stands, and a loud cheer went up, as the flying Maxwell began to pass car after car on the lap behind.

Aitken and Resta were running neck and neck at the end of the fifth lap and those in the pits and stands knew that it was not a question of driving, with these three leaders, so much as the ability to stand pace. The mass of steel that could endure the strain would win, as the pilots had even more power at their command then they could use, and it was not a matter of mere speed so much as of endurance and driving.

Rickenbacher Goes Out

Two cars rolled up to the pits in the sixth lap for spark plugs; these were

Ralph Mulford, whose Peugeot finished third in the 300-mile International Sweepstakes at Indianapolis

Wilcox in the Premier and Gaston Chevrolet in the Frontenac. In both cases oil had passed the pistons and sooted the plugs. In the meantime, while these cars were at the pits, the procession was streaming by with Rickenbacher still far out in the lead until, at the end of the ninth lap, his white car dropped from the race, a broken steering knuckle rendering useless all the power and speed of driver and engine.

With Rickenbacher out, the lead passed to Aitken, and at the end of the twelfth lap he and Resta were closely grouped and a quarter of a lap ahead of Mulford in another Peugeot. The three Peugeots, the products of France, made the pace through many a mile with the others in an ever-lengthening string behind them.

Chandler had to bring his car to the pits in the eighth and again in the twelfth lap to renew the gasket on his gasoline tank. This bothered him all through the race and cost him a position up near the front in the early stages of the grind. Others also were beginning to pay visits to the pits by this time. Anderson had to change the plugs on his Premier in the fifteenth lap, and the Sunbeam, driven by Christiaens, came in for a new left rear tire in the sixteenth.

Resta snatched the lead from Aitken in the seventeenth lap, when Aitken stopped for 20 sec. to change his right rear wheel.

This made the order in the eighteenth lap: Resta first, Aitken second, Merz third and Henderson, in the Maxwell, fourth. D'Alene's Duesenberg was then running sixth and gradually working its way through the field.

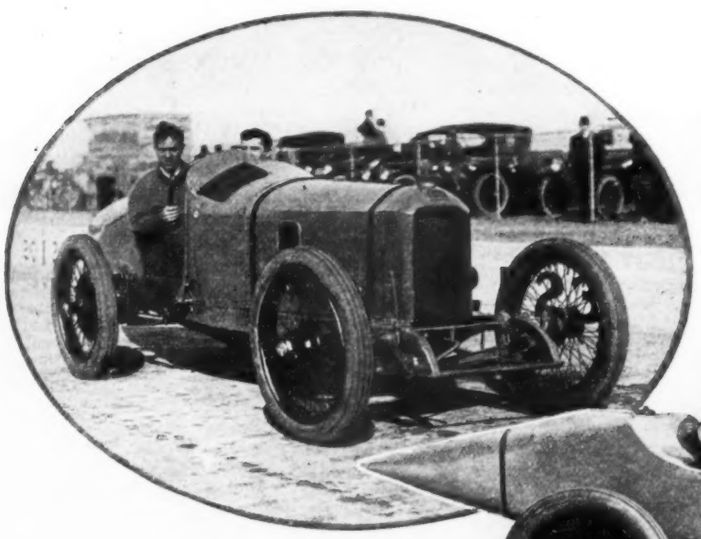
Aitken had to come in again in the twenty-fifth lap for another tire change. This was handled beautifully and he got away with a delay of but 22 sec. At the end of 50 miles, Aitken's two tire changes had left him in second place with Resta leading. Merz was a close third, Henderson fourth, Gaston Chevrolet fifth and D'Alene sixth.

A Steady Grind

The race had now settled down to a steady grind. It was a question even at this stage, whether or not Resta would fail. If his car continued to run the way it was going, and he did not make a stop so that Aitken would catch him, the race was his. He was about a half lap in the lead at 75 miles with Gaston Chevrolet, who had been driving a game race, up in third position. D'Alene had now pushed his way to fourth and Henderson was fifth. The race all along the line was exceedingly close and a stop for a shoe meant the loss of position.

When the 100-mile stage was reached Resta still held his uncomfortable lead of half a lap. Aitken was still pursuing him and D'Alene had gained a firm hold on third position in one of the prettiest driving exhibitions seen for some time. Gaston Chevrolet was in fourth place and Henderson fifth. Ralph Mulford was working his way toward the front also, and now held sixth with Devigne seventh.

In the next 50 miles Ralph Mulford showed some of the best speed of the day.



Left — Dario Resta, winner of the Indianapolis 300-mile race, at the wheel of his Peugeot

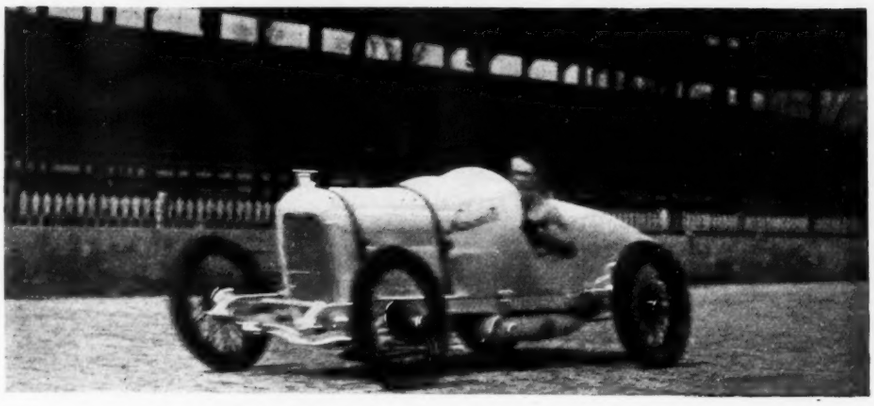
Right—Joseph Christiaens in his Sunbeam, which he piloted to fourth place in the Indianapolis 300-mile speed battle

He passed D'Alene, Chevrolet and Henderson and put himself into third position by his fast sprint. Here he lay in wait for the leaders to break themselves up, Henderson being now fourth and D'Alene fifth. In the sixty-eighth lap, Aitken had to stop again. This time he changed plugs and the delay of just over a minute allowed the flying Resta to gain another mile and a half or more. Immediately after, however, Resta, on his sixty-ninth lap, had to stop for a right rear tire, gasoline and oil.

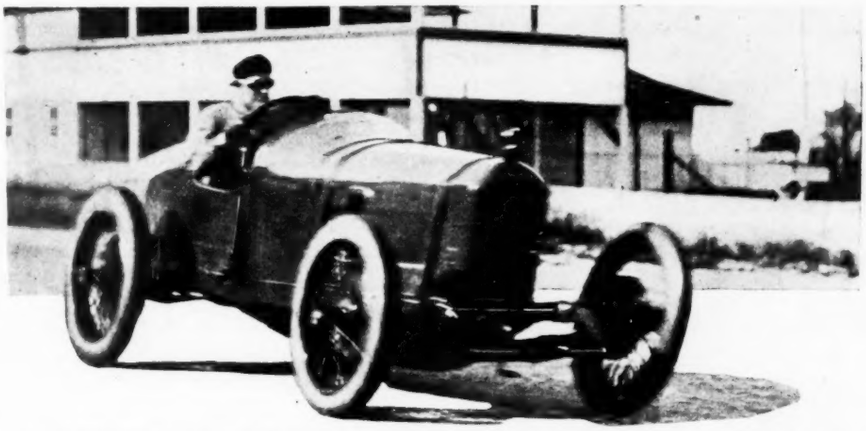
Aitken Succumbs

At the end of Aitken's sixty-ninth lap, the break came. Up to this time he always had a fighting chance, but a broken valve put him out of the running and left Resta safely up in front. Thus, at the end of the 200 miles Resta was far ahead, with Mulford second, Rickenbacher, who was now driving Henderson's Maxwell, in third place, D'Alene fourth, Anderson fifth and Christiaens sixth. The average for Resta at this time was 85.79 m.p.h., and he was driving very conservatively with 100 miles still to go.

A close fight for third position was now on. Resta held a substantial lead at the end of 225 miles, and Mulford seemed to have a firm grip on second place, but by forcing his car D'Alene passed Henderson and projected himself into third position. Anderson, who had been running fifth, went out with a broken rod in the seventy-fifth lap and that put Christiaens in his position.



Henderson's Maxwell, which finished in sixth position in the Indianapolis race, Rickenbacher driving, making fast time in a practice spin on the Hoosier speedway



John Aitken's Peugeot which made fast time up to the sixty-ninth lap of the race when a broken valve put him out of the running

D'Alene's Sprint

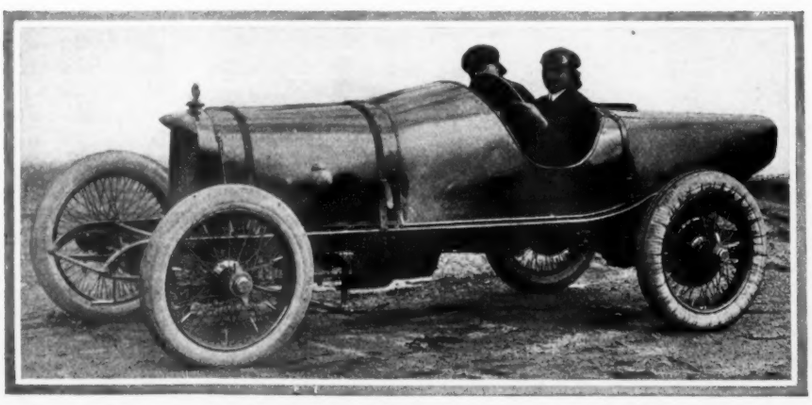
D'Alene, continuing his burst of speed, began to outdistance Mulford and, at the end of the 250 miles, was in second place. Mulford was then third with Christiaens fourth. Fifth place was held by Oldfield who had driven consistently throughout the entire race, and, as the leaders were eliminated, climbed higher and higher. Rickenbacher, in the Maxwell, was sixth, Haibe, in the Osteweg, seventh, Wilcox, in a Premier, eighth, Alley, in the Ogren, ninth and Johnson, in a Crawford, tenth.

This same order held at the end of the race, except that Wilcox succeeded in passing the Osteweg and Chandler in a Crawford managed to nose in ahead of Alley for seventh and ninth places respectively.

Resta flashed across the wire an easy winner. He had never really pushed his car during the race and the high safety factor under which he was working is shown by the fact that he only stopped once. His pit men had always kept him posted as to his lead since the early part of the race and he had never striven to put the lead up to more than enough to carry him through a safe winner.

The attendance at the race was estimated to total between 80,000 and 90,000, the usual proportion coming in their automobiles, while special trains to Indianapolis from Detroit, Chicago, Cleveland, New York and other large centers served their part in transporting speed-seeking motorists, near-motorists and members of the industry to the Hoosier saucer.

Arrangements at the track were excellent, the militia detachment guarding the course in accordance with the custom at previous Indianapolis classics keeping the best of order and preventing any untoward accidents to spectators.



Billy Chandler at the wheel of his Crawford Special, which captured ninth prize money in the Indianapolis race

Oldfield Breaks Record

Barney Oldfield, driving the front-drive Christie car, broke the lap record for Indianapolis speedway on May 28, when he covered the 2½-mile course at an average speed of 102.623 m.p.h. The previous record was made by Boillot, who was recently killed by German airmen while fighting in France. His time was 1:30.13. Oldfield covered the course in 1:27.70.

Times of Various Cars at Salient Points in the Indianapolis 300-Mile

AT 25 MILES		
Driver	Car	Time
Rickenbacher	Maxwell	14:50
Aitken	Peugeot	15:11
Resta	Peugeot	15:12
Henderson	Maxwell	15:52
Merz	Peugeot	15:59
Anderson	Premier	15:59
Christiaens	Sunbeam	16:00
Rooney	Premier	16:01
D'Alene	Duesenberg	16:02
L. Chevrolet	Frontenac	16:12
Oldfield	Delage	16:24
LeCain	Delage	16:24
Mulford	Peugeot	16:43
Haibe	Osteweg	16:54
Alley	Ogren	17:04
Johnson	Crawford	17:44
Chandler	Crawford	18:42
Lewis	Crawford	19:52
Wilcox	Premier	22:31
A. Chevrolet	Frontenac	25:09
Franchi	Peusun	27:11

AT 50 MILES		
Driver	Car	Time
Resta	Peugeot	32:17
Aitken	Peugeot	33:26
Henderson	Maxwell	33:52
Merz	Peugeot	33:53
D'Alene	Duesenberg	33:54
L. Chevrolet	Frontenac	33:54
Rooney	Premier	34:05
Le Cain	Delage	34:51
Christiaens	Sunbeam	35:07
Oldfield	Delage	35:26
Mulford	Peugeot	35:33
Alley	Ogren	35:39
Haibe	Osteweg	36:01
Anderson	Premier	38:39
Lewis	Crawford	38:40
Johnson	Crawford	39:02
Chandler	Crawford	40:44
A. Chevrolet	Frontenac	43:16
Wilcox	Premier	45:03

AT 100 MILES		
Driver	Car	Time
Resta	Peugeot	1:07:20
L. Chevrolet	Frontenac	1:09:37
D'Alene	Duesenberg	1:09:37
Aitken	Peugeot	1:10:09
Henderson	Maxwell	1:10:21
Oldfield	Delage	1:11:47
Mulford	Peugeot	1:12:08
Le Cain	Delage	1:13:00
Christiaens	Sunbeam	1:14:25
Rooney	Premier	1:14:29
Anderson	Premier	1:14:34
Haibe	Osteweg	1:15:01
Alley	Ogren	1:16:44
Lewis	Crawford	1:19:09
Johnson	Crawford	1:19:13
Chandler	Crawford	1:19:43
A. Chevrolet	Frontenac	2:03:59

Pit Work Better Than in Other Recent Races

Tire Changes in Less Than 1 Min.—Pit Rules Rigidly Observed by All

INDIANAPOLIS, IND., May 30—On the whole the pit work was better than that shown at Sheepshead Bay, where it was somewhat ragged. At Indianapolis tires were changed in times that ranged between 20 and 40 sec., and there were very few that took over 1 min. At New York several of the changes occupied far longer than they should have done.

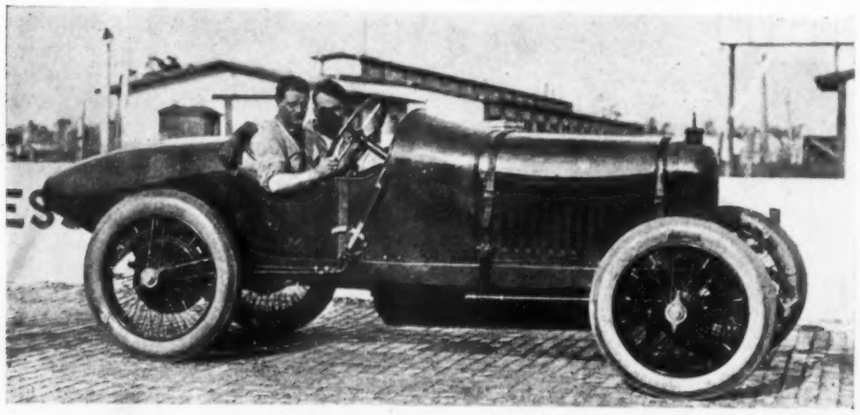
Some of the pits were in charge of ex-drivers who were thoroughly familiar with the work and saw to it that proper efficiency was shown in making changes or adjustments. The pit rules were rigidly adhered to by the attendants as well as the drivers and mechanics, and in no instance was there any tendency toward the infraction of the rule that allows only two men out of the pit at any time.

Tire inflations ranged on the average around 60 lb. Some of the drivers pump the tires to 100 lb. before starting the race, and then let the pressure down to the required amount. In this way any delay that may be caused by pumping is eliminated. The treads on the tires are not buffed off, as they have been on the faster tracks, because the centrifugal factor does not have to be reckoned with to such a degree. The tire changes are being made more often in all the races before the shoe blows. In that way it is possible to avoid limping around the track, and the danger of having a blow-out on a bad turn, where there are a number of cars bunched, is averted.

The right rear shoe is, of course, the one most susceptible to wear and the left front is least in danger of giving out. There were no changes in the race of front lefts, although on more than one occasion the right front was blown. It is the tire that must be watched most carefully on this track. Eddie Rickenbacher blew a right front shoe in practice just before the race. The tire went over the roof on the grandstand and the car spun around three times before it was brought under control. If this had occurred in a race with the cars bunched the results would have been disastrous.

The 5-in. tires are hard to steer on this track and, although they wear better, are harder on the driver. In fact, the difference is so noticeable that only drivers of more than ordinarily powerful build would care to manage a car so equipped. The use of smaller tires in front than in rear is quite common here, as will be noticed from the equipment table, and the difference in ease of steering is quite noticeable with these smaller wheels. It may be that the gyroscopic action of the wheels has something to do with this. It seems quite possible that this is so, when it is remembered that the drivers could not manage cars equipped with disk wheels on this track at all.

(*Continued on page* 996)



Gil Anderson in his Premier, who was put out of the race by a broken connecting-rod on the seventy-fifth lap when running in fifth position

Sweepstakes Race Held on May 30

AT 200 MILES			TIME OF FINISH		
Driver	Car	Time	Driver	Car	Time
Resta	Peugeot	2:18:03	Resta	Peugeot	3:34:17
Mulford	Peugeot	2:20:44	D'Alene	Duesenberg	3:36:15
Henderson*	Maxwell	2:24:15	Mulford	Peugeot	3:37:56
D'Alene	Duesenberg	2:24:39	Christiaens	Sunbeam	3:46:36
Christiaens	Sunbeam	2:29:01	Oldfield	Delage	3:47:19
Oldfield	Delage	2:30:55	Henderson*	Maxwell	3:49:56
Haibe	Osteweg	2:34:19	Wilcox	Premier	3:54:31
Wilcox	Premier	2:38:45	Johnson	Crawford	4:01:54
Alley	Ogren	2:41:39	Chandler	Crawford	4:02:43
Chandler	Crawford	2:47:07	Haibe	Osteweg	4:03:10
L. Chevrolet	Frontenac	2:54:19			

*Rickenbacher was now driving this car.

Osteweg Makes Good Showing in Initial Race at Indianapolis

A Description of This Special Car—Details of Design of This Special Car Hitherto Unavailable

The Osteweg car is fitted with a Wisconsin power plant that has been developed very much along the lines of the Delage.

The engine is a four-cylinder, sixteen-valve design having a bore of 4 11-32 and a stroke of 5 in. The cylinder casting is vertical and the valves are carried on each side, operating horizontally. The motor as far as the camshaft layout is concerned is the same as a T-head job, as there are two shafts, one located on each side of the crankshaft. The camshafts are driven off the timing set at the front end of the motor.

The Valve Action

The cams actuate long vertical push rods, four of which are located on each side of the motor. Each push rod operates two valves simultaneously. The push rods on the right take care of the intake and those on the left the exhaust. The rods bear against Y-shaped rocker arms which are so curved as to transform the motion given to them in a vertical direction by the push rods to a horizontal motion. The vertical rods bear against the stems of the Y and at the end of each of the branches there is a bearing against the end of the valve stem. Thus each rocker arm takes care of the two intake or two exhaust valves for one cylinder.

Other than in the valve action there is nothing about the motor which would distinguish it greatly from any other power plant. The pistons are magnalite and the dimensions of the pistons, valves, etc., are not radical. The valves have a clear opening diameter of 1¾ in. and the lift is ⅜ in. In transmitting the motion to the valves the rods pass up through the casting which forms in one piece, the manifold header and valve cover plate.

The exhaust manifold is carried overhead, while the intake is on the side as indicated. The carbureter is carried on the right side of the engine, but the make is not fixed as it is desired to try out several at the track before deciding.

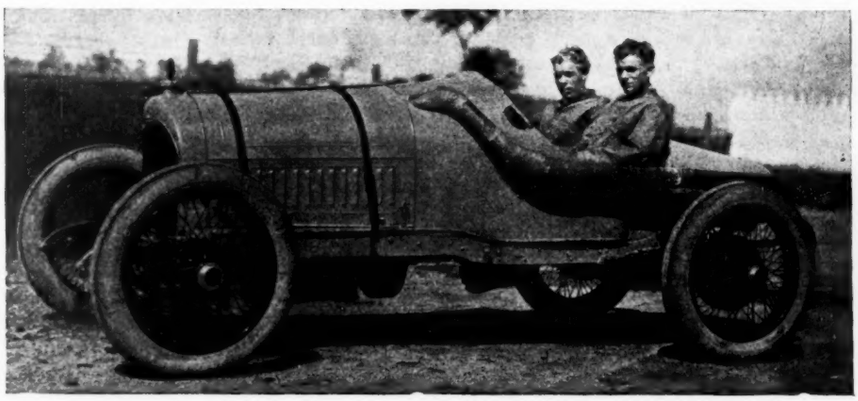
Three Main Bearings

Three main bearings are used on the crankshaft. These, unlike many of the racing cars, are plain babbitt lined bearings. The diameter of the crankshaft is 2 in. and the lengths of these bearings are 3¾ in. rear, 2½ in. front and 2 in. center.

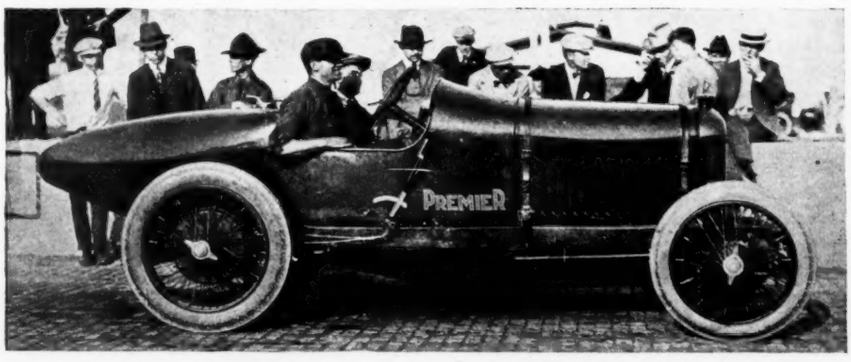
Standard design is used through the remainder of the chassis. The clutch is a cone and the gearset provides three speeds. Tires are Silvertown cords, 33 by 5 in. Springs are semi-elliptic and are used in conjunction with a Hotchkiss drive.

Oil and gasoline are carried in the tail of the car. The capacity of the gasoline tank is 25 gal. and that of the oil tank 7 gal. The tail piece is tapered off in a streamlike style, but does not extend back with a very extreme taper. The contour of the rear deck is flat compared to some of the other racing cars and the wheelbase is short, being but 102 in.

Ignition is by Bosch magneto, there is one set of plugs and the car carries Hartford shock absorbers all around.



Osteweg in the Osteweg Special, which, driven by Haibe, captured tenth prize money at Indianapolis



Tom Rooney in his Premier, which figured in one of the two accidents of the day, owing to the blowing of a shoe

Summing Up the Truck Final Drive Situation

Reasons for Using Different Forms for Different Purposes—Origin and Special Qualities of Gear and Worm Axles

By A. Ludlow Clayden

IN the development of the automobile there have been several periods during which vehement discussion raged concerning some particular feature of construction. In the early days of the passenger car there were bitter arguments between the protagonists of the sliding gear type of change speed which is now universal and of the theoretically far superior epicyclic mechanism. There were arguments concerning the proper place to locate the engine, whether it should be under the hood or somewhere beneath the body, whether accessibility or body space was the most important quality.

More recently we have had the battle of the cylinders, 1 vs. 2, 2 vs. 4, 4 vs. 6, and so on, right up to the present time when 12 vs. 16 looms in the offing.

It is not so very great a time since it appeared problematic as to whether steam or gasoline was to be the automobile motive power.

Looking back over some of these arguments it is interesting to observe how sometimes theory has triumphed and many times commerce has overmastered theory. In the question of sliding vs. constant mesh gearing, the exponents of the former type had nothing whatever to support their construction except simplicity. Every theoretical argument favored some other type of gearing.

To look at the other side, theory condemned the kind of simplicity which used to be typified by exposed unlubricated timing gears, non-automatic carbureters, etc. In these respects theory has been vindicated absolutely.

Practicability the Keynote

To-day engineers have come to realize that nearly every engineering problem in connection with automobile design construction resolves itself into a matter of *practicability*. Where alternative construction presents itself it is almost invariably found that one has advantages not possessed by the other, but also must own to especial disadvantages. Sometimes for some conditions of service one idea will be the best, on other occasions it may be the other construction which will strike the happiest medium.

It is easy in looking back over years to see how prominent men have changed their opinions, have in many cases eaten their own words as increasing experience has shown the truth to be different from their anticipation, but it is always possible in such a review of former happenings to notice that those who made mistakes made them because they overlooked some vital factor.

To-day there are still in progress very many arguments, but none of them so all-absorbing as were the particular ones cited above. Still the argument which circles about the final drive of the commercial vehicle has reached a pitch where it is not far behind the older controversies.

Conscious that I am treading upon dangerous ground, I propose briefly to review the developments of different types of truck axles, prefacing these remarks with the statement that there is no form of final drive for either a truck or a passenger car which is not a compromise. There is no form that does not possess disadvantages as well as advantages, and just as with everything else, a new sphere of action for the product demands a fresh examination of the whole subject to see how the balance of advantage and disadvantage may best be struck.

Early Forms of Drive

Again let us step back a few years to the time when all automobiles were, with very few exceptions, chain-driven. In those days we were still using extremely crude cars. The exposed timing gears above mentioned were still in vogue. Noise troubled us not at all and efficiency but little, therefore devices were adopted and used without protection and without special provision for lubrication.

In considering the final drive, it must be remembered that a chain in those days was vastly inferior to the chain of to-day. The art of chain making was then in its infancy. The materials available were not of the same quality, and chain manufacturers were often unable to judge which was the best material to use, lacking almost all the experience they now possess. This situation created two schools of engineer: one adhered to the chain, improved it, devised cases and means for automatic lubrication; the other seeing that the chain run dry was in a way unsatisfactory, turned to some totally different types of mechanism; whereby the propeller shaft and live axle transmission was created. Once discovered, the live axle was cheaper than a chain drive with proper inclosure, and it required a little less attention, although the attention demanded by a properly protected chain is very small indeed.

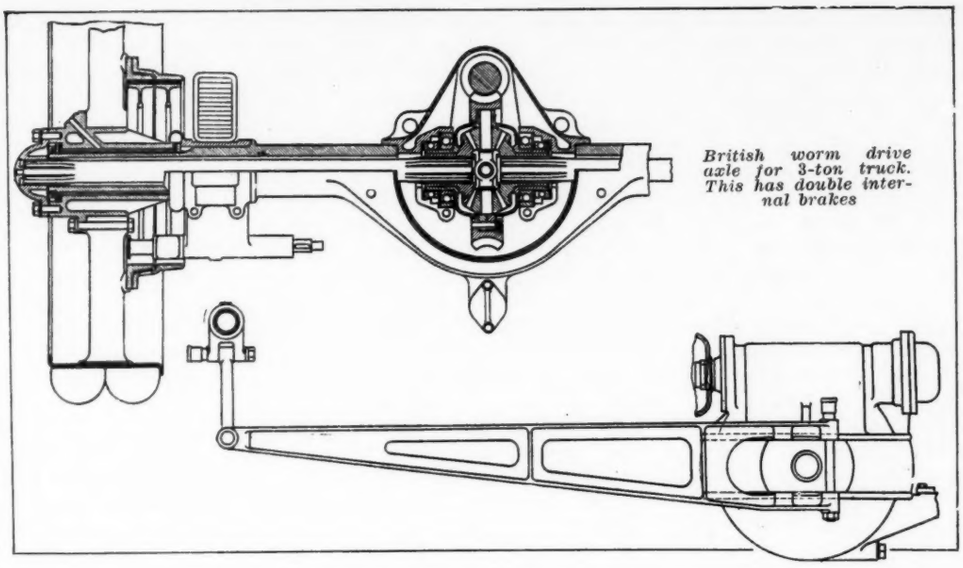
Meanwhile, the commercial vehicle was developing. The earlier types, patterned upon the passenger car chassis, adopted the exposed chain drive. When the live axle was developed with the passenger machine, there were two things to prevent its adoption on a heavy vehicle; one was that it was impossible to house a bevel gear giving a sufficient reduction in an axle case of practical size, and the other was that the earlier live axles on passenger cars gave frequent trouble through lack of strength arising from the lack of experience of the designer.

Improvements in Chains

Chains all the time were being improved. The good chain or, alternatively, practical methods for inclosing the chain, arrived too late to compete seriously with the live axle for passenger cars. But they did not arrive too late to retard the development of live axles for commercial vehicles. In 1906, or thereabouts, chains were giving excellent service in commercial work, although they had been almost completely abandoned for passenger cars.

There is no question that a well-made chain running on well cut sprockets is an efficient method of transmitting

power, and it is unfortunate from the chain viewpoint that a poorly-made chain on badly cut sprockets is still fairly efficient and will operate with moderate satisfaction. Had it been *essential* to make a chain well and mount it properly, had it been *impossible* to "get away" with a poor chain layout, this form of drive could never have been attacked on the score of noise or lack of durability when inclosed.



British worm drive axle for 3-ton truck. This has double internal brakes

The Internal Gear

The live axle took France and Germany by storm, so the French and German engineers turned at once to the development of something other than a chain drive when they started to make heavy vehicles. There is no need to recapitulate all the steps. Many different kinds of mechanism were tried, but the German Daimler company took up the already known principle of the internal gear drive and developed it so that it was very reliable. The same mistake was made as had been made with the chain, namely, the ring gear and pinion were run exposed and unprotected, so the transmission rapidly became noisy and it wore out with moderate rapidity. Still at that time the German Daimler company knew more about materials than any other automobile firm in the world, and for this reason their axle was able to give excellent service. It did not take long for other firms to see how greatly the Daimler axle could be improved by arranging for the inclosing and lubrication of the pinion and ring gear. The details have been worked out by many different firms in Europe and in America. There are all kinds of designs just as there are all kinds of automobiles. Some are elaborate, with the utmost regard paid to the perfection of every detail. Others are much simpler and sometimes less durable and less efficient.

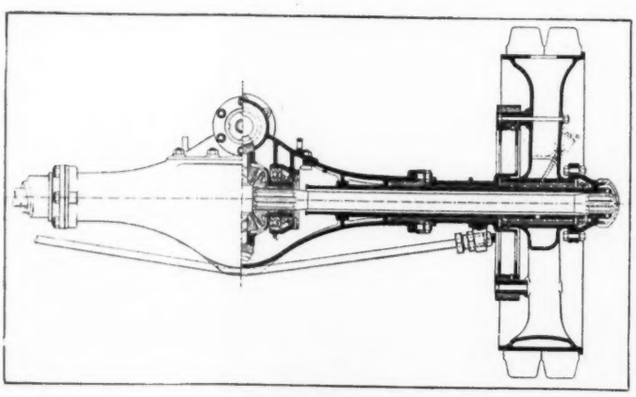
Returning to the historical view, the noise created by the worn, unprotected Daimler axles had its effect in England and elsewhere. The British engineers preferred not to follow the lead of the continental men, that is to say, instead of taking the original Daimler axle and making the few necessary improvements, they commenced to evolve an entirely different sort of inclosed commercial vehicle axle. This produced a type rare in America but widely used in Europe to-day. This is the *double reduction axle* wherein a propellor shaft drives a bevel gear which operates a differential. This is mounted above the main driveshaft in an axle case, and from the differential the drive to the wheels passes through two pairs of spur gears, one on each side of the differential. The principle is another form of the internal gear, only instead of using pinions and a ring gear, two spur gears are used located in the center of the axle. The internal gear type has the weight carried on a dead axle and the power transmitted through a differential and driveshaft affixed to the dead axle. The double reduction type is essentially of live axle design, the weight being borne by the casing which incloses all the gearing.

The internal gear and the double reduction types of axle are alternative ways of doing precisely the same thing.

Taking some of the comparative points, the internal gear axle can be made to provide a somewhat greater road clearance at the center and probably, if the standard of engineering is equal, it should be a trifle lighter, owing to the fact that the rotating driving members turn at higher speed and therefore can be made smaller.

On the other hand, to take the question of brakes, it is immediately obvious that it is easier to accommodate wide internal brakes on the road wheels with a double reduction type of axle than with the internal gear drive, because of the space which must necessarily be occupied by the ring gear.

One could easily proceed along this line of analysis, going into very great detail, but sufficient has been said to show the choice between two forms is a question for the individual engineer. Some little thing in connection with the problem before him may cause him to decide in favor of one type more than the other. It may be that he requires an exceptional ground clearance or some other factor may be uppermost in his mind.



A worm gear axle of British construction very like the London omnibus axle

The Worm Gear Arrives

Nearly simultaneous with the above developments, we see the arrival of the worm gear. Owing to the noisiness of the early London omnibuses, both chain and internal gear driven, public clamor became so insistent that police regulations were adopted in which Scotland Yard was empowered to withdraw from service any omnibus which in the opinion of their inspectors was excessively noisy, requiring the car to be examined by their agents before again allowing it to run. Under these regulations enormous financial loss to the omnibus companies resulted owing to the difficulty of maintaining traffic. Matters finally reached so acute a point that any form of drive promising quietness was considered. One of the early English trucks, the Dennis, had for some years been worm driven and several of the omnibus companies replaced the final drive system on some of their omnibuses

with Dennis worm drive axles. Whatever faults were developed that of noisiness, the most important of all, was eliminated and after trial the worm drive was adopted as the standard London omnibus final drive. Used by the omnibus companies, care naturally was taken in lubrication, gears were examined, bearings adjusted when necessary. Run under these conditions it soon became obvious that a worm drive would last for 30,000 or more miles, and it was argued that, despite the careful attention, bus service was particularly arduous in one respect, owing to the enormous amount of starting and stopping. Nearly simultaneously noise in the gearset was eliminated by means of a peculiar type of silent-chain jaw-clutch transmission. The modern London omnibus is thus a peculiar combination of all the elements wherein elimination of noise has been the dominating object.

With the enormous demand of the omnibus companies for ultra-quiet chassis, the British truck industry equipped itself to supply such vehicles and gradually developed the various peculiar elements to a high state of efficiency. It was, of course, natural that the same chassis should be utilized for freight haulage, especially since the road conditions in England do not demand the same ruggedness of chassis construction required in America.

Some Disadvantages

With the development of the worm for heavy passenger and freight haulage, it was quite natural that the silentness and smoothness of the worm should attract pleasure car designers and many British builders adopted the worm drive for their pleasure cars. The difficulty of obtaining clearance with the underslung worm and the necessity of placing an inconvenient tunnel in the floor boards of the rear seats with the overhung type, together with such engineering difficulties as were encountered by car builders improperly equipped to build good worm drives, caused some firms to return to bevel gears.

For reasons which need not be gone into here, the development in design of the commercial vehicle in America was much slower than its European development. The European truck industry was almost grown up when the American industry was in its infancy. Thus, at the time when the chain drive had given way to the internal gear in continental Europe, and to the worm or double reduction axle in England, it remained supreme in America. This means that when the American industry gave serious attention to the design of commercial vehicles, it found three distinct types of axles, each in a high state of development, from which to choose as an alternative to the chain, and, just as their European colleagues had done before them, the American engineers plunged for the new idea instead of taking the chain drive and giving it a proper chance by making it properly and applying it in accordance with correct principles.

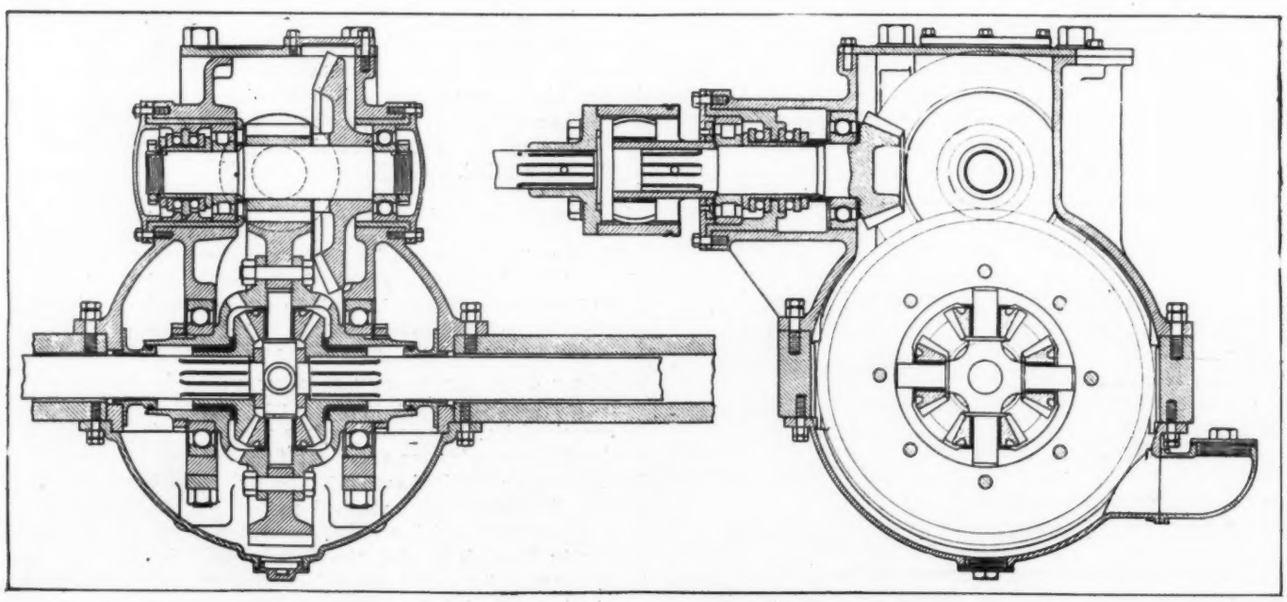
The Double-Reduction Axle

It is curious that the double-reduction axle is not used by more manufacturers in America to-day. Probably the explanation is psychological. Certain engineers thought they would be wisest if they were guided by the experiments of France or Germany, and studying their field, naturally it appeared that the internal gear drive was the predominant type. Others looked particularly to England, and these naturally received the impression that the worm gear or the double reduction axle was the best. Excellent arrangements were made by American firms with those who had developed the worm in England, so that, from the start of real activity in the commercial car field, American makers have been able to buy thoroughly good worm gears.

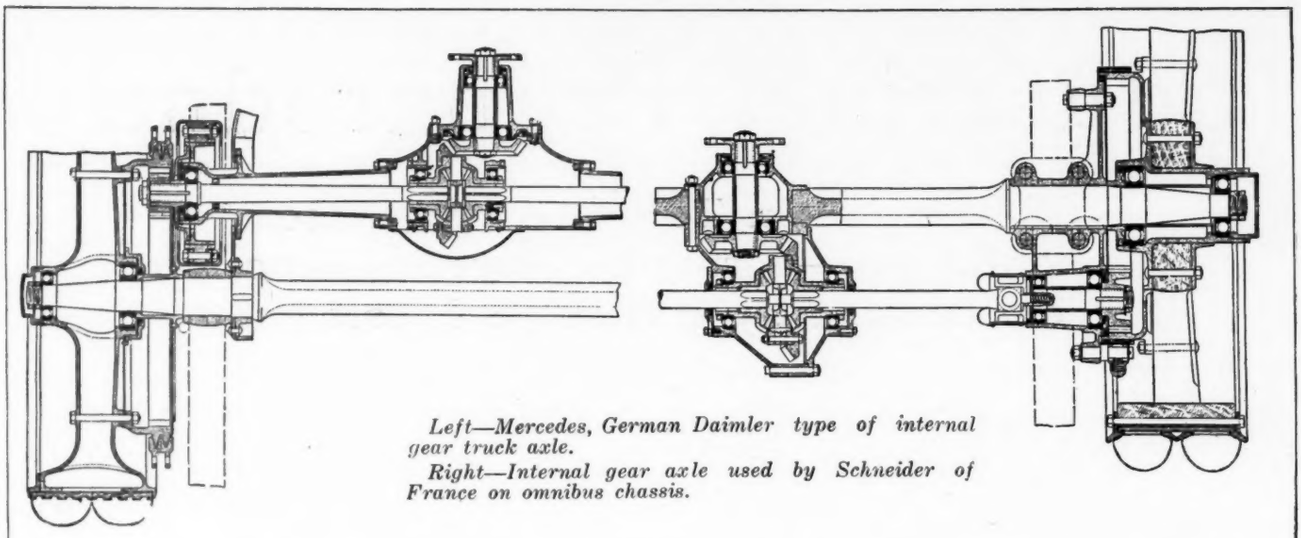
In this connection it is interesting to observe that the tendency in this country has been for the worm to be adopted for heavy vehicles and the internal gear axle for lighter types. The reason why the worm was taken up for the heavier machines when the point of discarding the chain had been reached was two-fold. Firstly, it so happened that the Pierce-Arrow company, owing to certain affiliations, was looking to *England* for the results of experience in commercial vehicles at that time. Secondly, it happened that the London omnibus was a 3-ton machine, so the enormous amount of data collected was a very direct value in applying the worm to a heavy truck.

Summing up: the worm axle has the advantages of permanent quietness, of oil bath lubrication for every part, and of every facility in brake application and design.

The introduction of the internal gear final drive unquestionably antedated the manufacture of commercial vehicles in the United States; thus it was the readiest idea to adopt at the time designers began to give serious thought to the problem of replacing the chain with shaft drive in truck use. Furthermore, live axles on passenger cars were still none too strong, and so the dead axle feature of the type was very attractive. It is also claimed with complete justification that



A typical British double reduction axle approved under the war subsidy scheme



Left—Mercedes, German Daimler type of internal gear truck axle.
Right—Internal gear axle used by Schneider of France on omnibus chassis.

ignorant adjustment or improper lubrication can do little harm to anything except easily renewable parts.

No Ultimate Form

The question as to what form of final drive will be eventually triumphant appears to be unimportant, since it will be settled by the law of supply and demand. Supply and demand for certain specialized qualities, i. e., quietness, brought the worm gear into existence as a factor in truck construction via the London omnibus. The law of supply and demand for other qualities brought the internal gear axle for light trucks on the American market—elimination of chain troubles. When, and as long as, worm axles and internal gear axles can be produced at about the same price, they will both continue in existence.

It is far from improbable that we shall see the introduction of the double-reduction design to America, for it has special points to recommend it. *None of the three types was chosen or will be chosen for its theoretical perfection.* Each came into existence because it seemed to certain engineers to be the best way of answering certain conditions and these conditions varied a little with the locality. They were different in England from what they were in Germany; different in America from what they are in Europe.

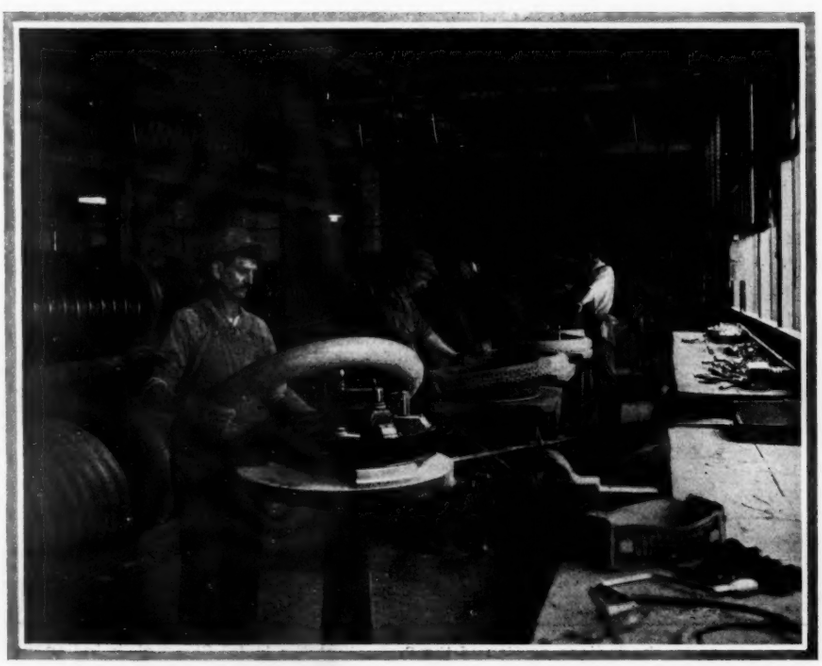
Thus, in the final analysis, it is well to remember that all engineering is a compromise. If it were possible to incorporate *all* the advantages of any unit in *one* special construction, it would be foolish for engineers to consider any other type whatever.

It is no more likely there will be a single, ultimate form of final drive than that there will be a single, ultimate design of engine.

Time-Saving in Assembling Chalmers Wheels

IN a factory that moves at top speed in every department, efficiency experts find that it pays to accelerate on the small jobs.

At the factory of the Chalmers Motor Co., Detroit, Mich., the method of placing the rims and tires on the wheels is an admirable illustration of time-saving. Four men in this department assemble wheels, tires and rims for an output running over 125 cars per day, everything possible being done to expedite the work and to make things convenient for the men performing it.



Separate racks contain the rims, wheels and tires with deflated tubes. The man at the left of the illustration operates a device which springs the rim open so that the tire can be placed in position. He then locks the rim and passes the job on to the next man. The tire is inflated and again passes to another man who places the rim on the wheel. The nuts holding the demountable rims in position are put on with the aid of a compressed-air wrench.

Industrial Preparedness

Howard Coffin Tells S. A. E. Reasons for Scheme—Part to Be Played by Automobile Industry Has Huge Importance

INDIANAPOLIS, IND., May 29—One of the most impressive of the race-time functions at Indianapolis was the preparedness dinner given by the Indiana section of the Society of Automobile Engineers at the Claypool Hotel Monday night. Howard Coffin, chairman of the Committee on Industrial Preparedness, a sub-division of the Naval Consulting Board, was the principal speaker.

The meeting was presided over by F. E. Moscovics, chairman of the Indiana section of the S. A. E.

S. A. E. to Have Important Rôle

Probably of the greatest interest to the automobile industry was the explanation by Mr. Coffin of why the Society of Automobile Engineers was not invited to join actively in the work of the industrial committee. He explained that this was due to the much more intimate part that the S. A. E. would be called upon to perform in handling the questions of motor transportation, which are of the first magnitude under present conditions of warfare. He stated that under pending legislation, particularly the Chamberlain bill, it is very well possible that the members of the S. A. E. will be organized into a highly-efficient transport group which will take care of the movements of motor trucks and passenger cars in army service.

Mr. Coffin's speech follows in part:

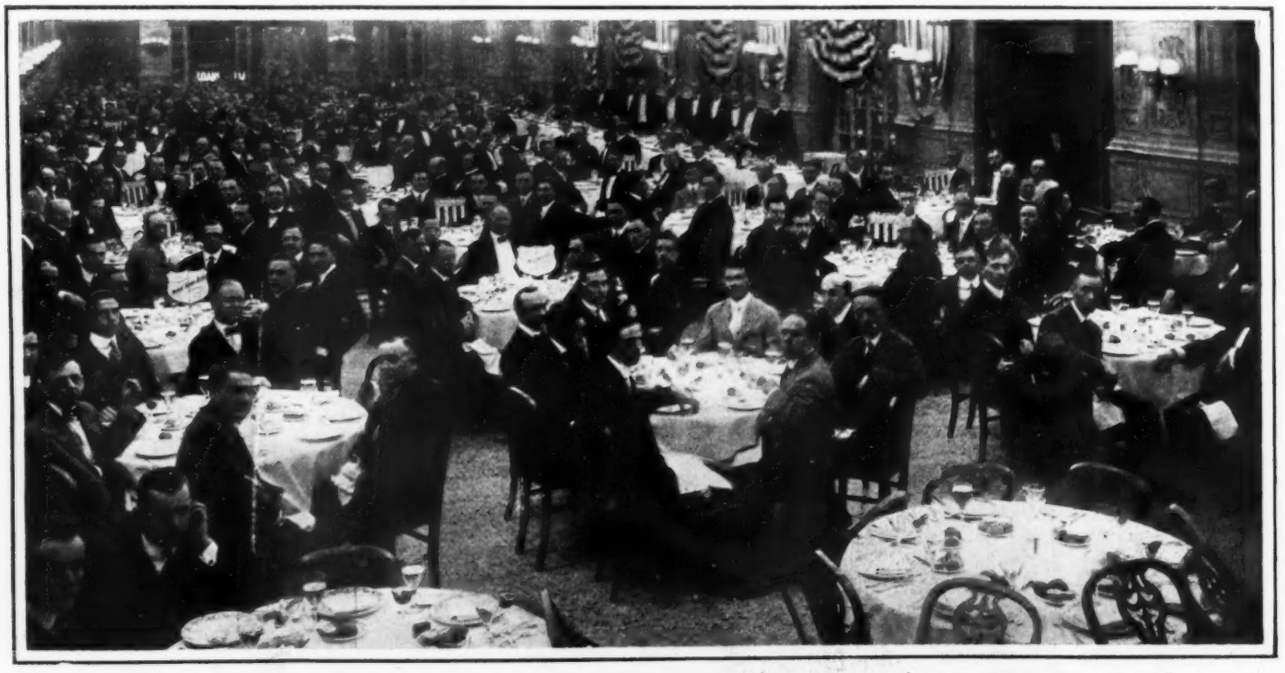
I have been asked to talk to you about preparedness, but I am going to deal with a kind of preparedness about which we have heard little. To most of us the word brings visions of marching soldiers and of battle-ships in fighting trim. We are all of us thrilled by sound of drum and fife, and interested in the saber-clanking kind of preparedness. This sort of thing appeals to our imagination and is in line with all the war stories we have read since we were children.

It is a matter of our common knowledge that we are not a militaristic nation. Saber-clanking is not in our line and never will be for any great length of time. It should be clear to us, therefore, that if we are to adopt any policy of preparedness—and expect it to be a consistent policy which can be maintained through the years of peace, as it must be if we are ever to be fitted to defend this country when war threatens—that policy must be one in keeping with the traditions and ideals of this nation.

It is this kind of preparedness about which I wish to talk to you. This *industrial preparedness is basic preparedness.* Two years of observation of the European war has taught us organized industry is the foundation upon which we must rest any and every plan for our military preparedness for defense.

Between 80 and 90 per cent of the manufacturing and producing resources of the European countries are engaged in the making of supplies for their armies. In the event that we are so unfortunate as to become involved in an argument with any first-class foreign power, an equal percentage of our manufacturing equipment will be needed in this same service.

Industrial preparedness is strictly in keeping with the natural tendencies and abilities of our people. It is the



Preparedness dinner given by the Indiana section of the S. A. E. at the Hotel Claypool in Indianapolis on May 29

cheapest form of preparedness. We already have the investments in plants, in tools, in machinery—and more important still, our investment in skilled workers. A soldier may be made in a year—it takes many years to make a toolmaker.

As I have said, we have all this equipment in our hands—but it is unorganized and uneducated for national services. All of us in this audience know that we cannot expect any big manufacturing plant to change over in less than one year's time from its usual commercial line, to a product with which its manufacturing departments have had no previous experience. And yet that is exactly what at least 80 per cent of our plants would be called upon to do in case of a real war.

In England the situation should be of particular interest to us for two reasons: Firstly her traditions, conditions and governmental methods are more nearly parallel our own. Secondly her policies—again probably paralleling our own under similar conditions—afford us a glaring example of what best not to do.

No record of skilled labor was available—and thousands upon thousands of skilled workers have been wasted at the front who would have been worth their weight in gold in the factories at home.

In the meanwhile some interesting things were happening in Germany. I cannot better illustrate than by quoting a true story told me by an eye witness. There is one big manufacturing plant in Germany well known to you all. A telegram announcing the declaration of war was received at 2 o'clock in the afternoon.

Bells rang throughout the plant and the men past their pay windows, receiving slips of paper which carried their instructions. One per cent of them left the plant at once on the way to their concentration points; others proceeded to the storerooms in which were kept the gages, jigs and tools for use in the production of that material of war for which that great plant, through careful prearrangement, was to be held responsible. Others of the workmen left at once to report as experts in matters of ignition on aeroplanes and motor vehicles.

The machinery scarcely even stopped. A few hours at most in shifting jigs and changing setups and the change from the commercial product to the war product had been made.

Here, in this simple story we find the meat of true preparedness. In this story we have illustrated the kind of preparedness which really appeals to us as of practical utility.

The United States has manufacturing facilities twice as great as those of any other nation. None can compete with us in this respect. It is this vast industrial resource that the Naval Consulting Board seeks to develop. This is a non-partisan body and among its sub-committees is that on industrial preparedness. This committee has spread beyond the confines of its original scope and, realizing the importance of industry in war, has set about to organize it so that it will be available instantly in time of need.

Mr. Coffin mentioned several striking examples of unpreparedness among the nations and contrasted them with conditions that existed in Germany just before the opening of the war. He stated that Germany had sixty thousand machine guns before the war. At the rate of manufacture in England after the war had run 6 months it would have taken 30 years to catch up with Germany, even neglecting the daily output in that country.

Example after example showing the astonishingly sudden change to chaotic conditions in our own and other nations after the opening of the war were mentioned by Mr. Coffin. He told how concerns were forced into bankruptcy due to rejected munitions and misfit parts.

The great work of the industrial preparedness committee in listing the different manufacturing concerns and determining just what work each would be fitted to do was one of the important parts of Mr. Coffin's talk. Every plant that has tool equipment is included in this and the scope of the plan covers every industry, every machine and every man as well as the plant itself. Those plants which do not fall into the scheme would be stripped of men in time of war.

In pointing out the great necessity of the assistance of the S. A. E., Mr. Coffin mentioned that in the United States in January, 1916, there were 2,400,000 cars as compared to 800,000 in the rest of the world. In this connection he also spoke of the immense value of the proposed road system on which $150,000,000 will be spent in the next five years.

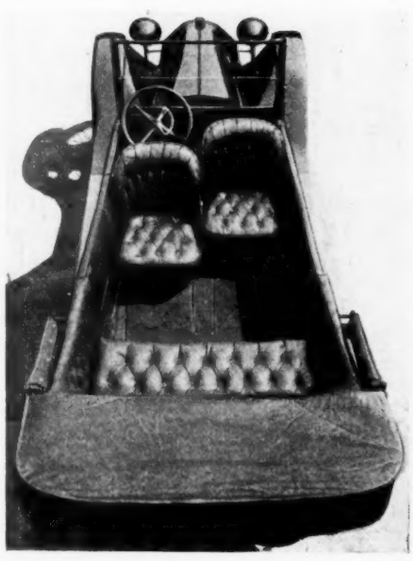
A brief review of the pending acts in the Legislature was given by Mr. Coffin, who announced himself as favoring very strongly the Chamberlain bill, which goes deeply into the measure of preparedness and clears the way for several steps which have heretofore been impossible on account of adverse laws. He stated that he believed this bill would become a law within 30 days. The creation of a $20,000,000 nitrate plant was also touched upon as an immediate need. The aim of the entire movement is to place the industries of this country upon a footing where they will be able to shift from a peace to a war basis without confusion in 30 days.

About 350 engineers and members of the industry and important clubs attended, and Mr. Coffin's speech was applauded with intense enthusiasm by the audience that had spent nearly 2 hr. in close attention.

Formula for Making Curing Acid

Nearly all repairmen will be interested in knowing the formula for making curing acid, as it is often inconvenient to have to obtain this acid from the manufacturers of the repair materials. The formula is as follows, according to directions given by the Goodyear Tire & Rubber Co., Akron, Ohio: Add 1.7 fluid oz. (5 centilitres) of sulphur chloride (S_2CL_2) to 1 gal. (3.79 liters) of carbon tetrachloride (CCL_4).

Studebaker Fits Flexible Seating



AS an indication of what can be done in the way of pleasing and useful body construction even where a large output is the rule, the Studebaker body with its individual and movable front seats which is being fitted to the four- and six-cylinder chassis made by the Studebaker Corp. stands out strongly. It is surprising how useful such an arrangement is, for not only can each front passenger enjoy extreme riding comfort but the car may be utilized in a very sociable way by lifting these seats from their sockets in the car floor and turning them around. This feature lends itself admirably to picnics and camping expeditions, for the chairs can also be made to do duty on the ground as well. Not only are the seats removable, but they are adjustable as to leg room by moving them forward or back within a wide range.

Four-Cycle Engine—Two-Stroke Effect

Novel Design Gives Impulse Every Down Stroke in Each Cylinder—Piston Valves Employed

THERE have been very few attempts to design gasoline engines which will give an impulse every revolution in each cylinder, excepting two-stroke motors. The Strickland engine is a novel effort in this direction and possesses several points of interest. The system is explained almost completely by the illustrations.

First, there is a two-diameter piston, and the cylinder has the usual combustion space at the top. Midway of the cylinder length there is an annular space left when the piston is at the top dead center, and this forms a secondary combustion chamber. The idea is somewhat similar to the two-cycle wherein the lower part of the piston is used as a pump, but in this case both upper and lower parts are working pistons.

The action is as follows: As the piston descends under the impulse of a charge in the upper combustion chamber the lower part of the piston is drawing in gas from the carbureter.

On the reversal at the bottom of the stroke the upper piston commences its exhaust stroke and the lower part rises on the compression stroke.

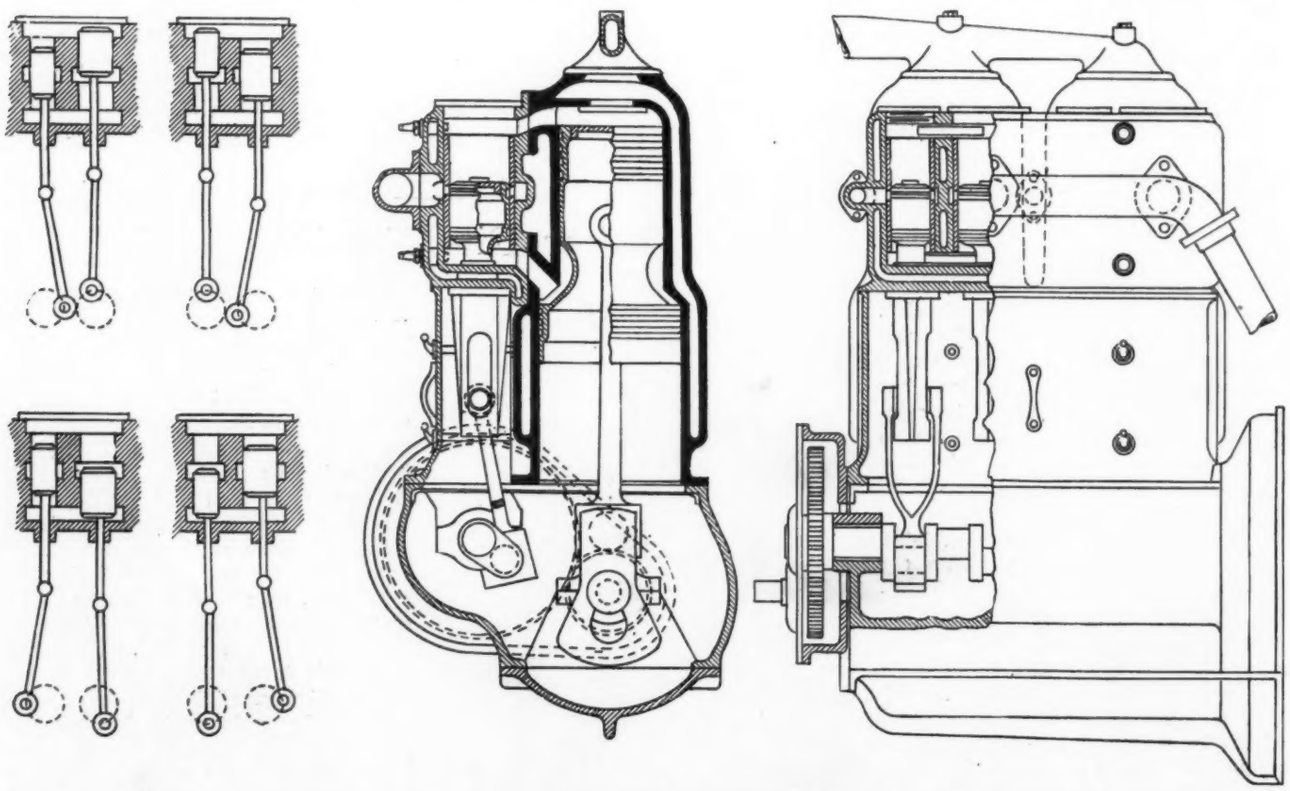
In the next stroke firing and expansion take place in the lower part and intake on the upper piston.

For the last stroke the upper part is compressing while the lower is exhausting.

Obviously it would need somewhat complicated mechanism to control the intake and exhaust with poppet valves, as two separate sets would be required, so the inventor has very ingeniously arranged a single pair of double-acting piston valves to control both the upper and the lower cycles. These are shown on the left of the engine in the illustration. Intake and exhaust take place through the two ports shown in the middle of each valve piston stroke. When the piston controlling the exhaust or intake is at the bottom of its stroke it uncovers the port so as to connect it with the upper combustion space. When the valve piston is at the top of a stroke, the same middle port is put into communication with the lower combustion space. There is a second crankshaft for operating the valves, this being driven by gear from the main crankshaft.

The exhaust parts are large enough to let off exhaust pressure quickly by the number of ports inserted in the circumference of the bushing. The inlet bushing has a lesser number of ports which are narrow and long and are gradually opened up in area as the main piston approaches the middle of the suction stroke, at which point occurs the greatest inrush of mixture.

During the exhaust stroke of the upper piston area the crank of the exhaust valve is moving across the lower dead center, during the suction stroke the exhaust piston is traveling upward in the bushing, during the compression stroke the crank of the exhaust valve is traveling across the upper dead center, and during the explosion stroke the exhaust valve or piston is traveling down a little in advance of the main piston,



Strickland double-acting, four-stroke engine. The successive positions of the two piston valves which control both the upper and lower combustion spaces are shown at the left

to let the charge off before this piston arrives at the lower end of the stroke.

In like manner the inlet valve, which is adjacent to the exhaust, is going through similar operations in relation to the intake stroke of the main piston.

As the cycles of operation are plainly set forth in the diagram it is also seen and understood that each piston valve is alternately supplying and exhausting gas to the upper and lower area from the common inlet and exhaust passage or port located between the combustion chamber at the middle of the bushing.

The inlet valve is at the farthest point of travel during the explosion, thereby bringing all the rings on it into action to guard against leakage to the supply chamber.

The inlet valve and the main piston are also guarded against leakage to the opposite side by a vented groove between the inner set of rings.

The inventor lays particular stress on two points in connection with his design. The first is that the effect of the piston valves is to extend the indicator diagram, thus making for increased thermal efficiency. The reason for this is that the piston valves are near the top of their stroke during suction and descend during the firing stroke (and *vice versa* for the lower combustion space), thus having the effect of making the cylinder bigger during the expansion stroke than it is during the suction stroke. This follows the principle of the Atkinson cycle.

The other claim is, of course, that the space occupied is much smaller for a given power output than for a four-stroke engine of equivalent power. According to the drawings made for the two-cylinder design, the length is 0.7 the length of a four-cylinder engine of conventional design with equivalent piston displacement.

The inventor also points out that the weight of the double pistons is not excessive. Allowing for the weight of the connecting-rods, it is claimed that the compound pistons with their two rods weigh 35 per cent less than four pistons and four rods to give equivalent power with single action.

Testing for the Flash Point of Oils

THE Flash Point of Oils is the title of technical paper 49 of Petroleum Technology 10 issued by the Department of the Interior, Bureau of Mines, Washington, D. C. The paper goes into a consideration of the different methods of testing for flash point and in the conclusions makes the following statement:

Two Accurate Testers

"The most accurate tester and the tester that most nearly reproduces actual working conditions should be adopted for official tests. If all of the above factors be considered, it is believed that these two testers, the Abel-Pensky and the Pensky-Martens, as modified by the Bureau of Mines most nearly meet the desired conditions.

"The Bureau of Mines flash testers have been officially adopted by the National Fire Protection Assn. and the Independent Petroleum Marketers' Assn. of the United States.

The important factors to be considered in the construction and manipulation of an instrument for determining the flash point of an oil may be cited as follows:

1—The conditions under which the test vapors are generated should be as like as possible for the conditions found in practice.

2—Corrections should be made for variations from the normal barometric pressure.

3—The shape and dimensions of the cup should be definite.

4—The size, shape, depth of immersion and exposed part of the thermometer should be definite and the thermometer should always be calibrated. The thermometer should be calibrated when immersed to the collar, 60 mm. from its lower end.

5—The oil should never be exposed for any length of time at temperatures greatly higher or lower than the normal temperature.

6—The rate of heating on testing should be constant and at the rate of about 1 deg. C. per minute for lamp oils and 3 deg. to 5 deg. C. per minute for oils with a high flash point.

7—The oil being tested should be uniformly stirred during the test.

8—The test flame should be of definite size; it should be exposed at a fixed distance above the surface of the oil and for a definite length of time.

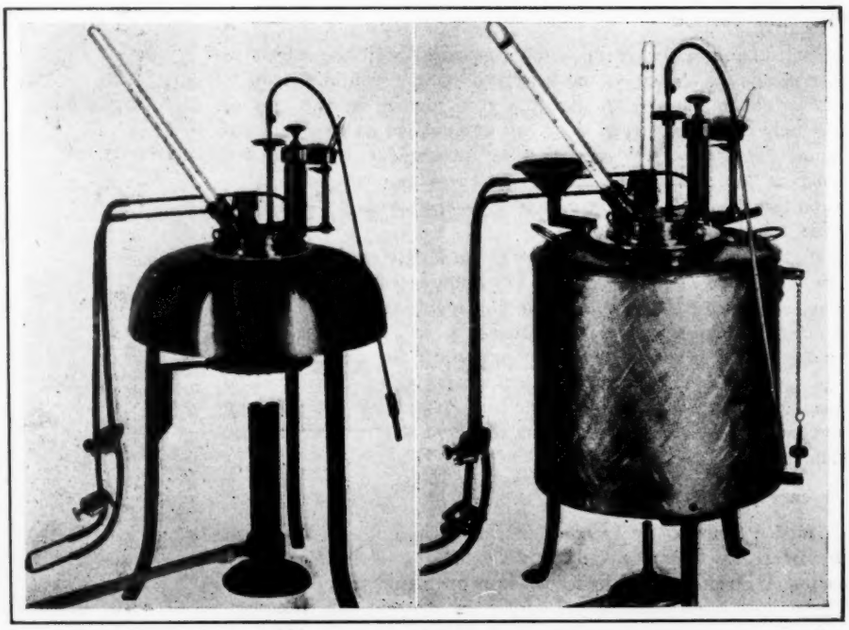
9—All water should be removed from the oil prior to testing.

10—In general testing, so far as possible, the personal equation of operators should be eliminated, and the manipulation of the tester made entirely mechanical and automatic.

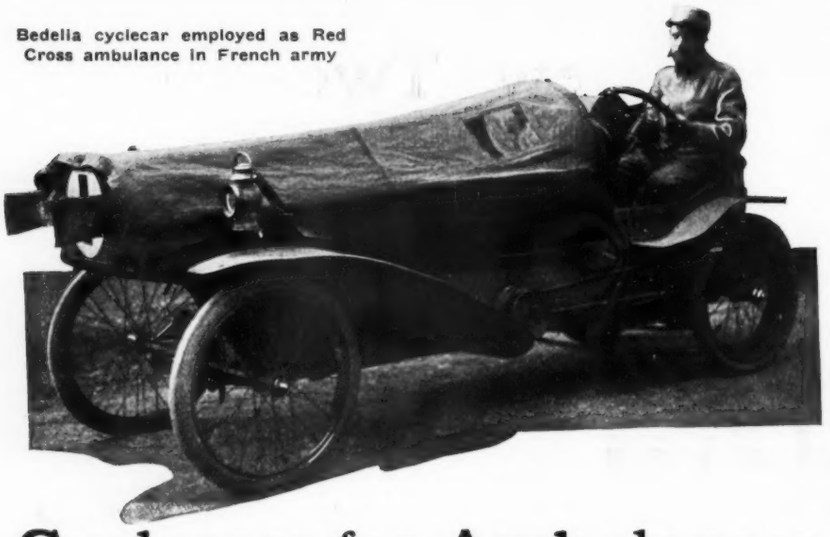
The booklet goes into an analysis of the different kinds of testing instruments, showing the defects of each classification and the manner in which tests should be made in each.

No attempt has been made in this paper to place a relative value on any of the conditions determining a fire hazard but the paper does describe attempts to definitely establish a method of determining a particular thing—the flashpoint—as one factor in the conditions governing the danger.

A requirement that an oil shall have the highest practicable flashpoint, as such a requirement tends to reduce the fire hazard to a minimum and is praiseworthy and humane. But to require too high a flashpoint may, in the case of a lamp oil, impair the burning qualities of the oil and also work a hardship on the refiner.



Abel-Pensky and the Pensky-Martens testers as modified by the Bureau of Mines



Bedelia cyclecar employed as Red Cross ambulance in French army

Cyclecars for Ambulances

Bedelias Reach Inaccessible Places—Propose Taylor System for Munitions Works

PARIS, May 5—Cyclecars are now being made use of in the French army as an auxiliary to the Red Cross service. The regulation automobile ambulance carrying four men lying are unable, owing to their size and weight, to get close to the first aid dressing stations. Thus wounded men have to be first brought to the rear on stretchers before they can be placed in the automobile ambulances. Experiments which have been carried out in the Soissons district with Bedelia twin-cylinder air-cooled cyclecars show that these machines can travel as far forward as the stretcher men can penetrate, and that they can bring wounded cases back much quicker than it is possible to do it by hand. As there is no fear of a machine getting into a position from which it cannot be extricated by a few willing helpers, the driver of a cyclecar does not hesitate to go forward where a motor ambulance driver would hold back.

One Man Carried

The machines are twin tandem seaters, with the motor in front and the driver at the rear. Only one wounded man is carried at a time. The stretcher is placed on the top of the body and attached to it by coil springs, so as to give additional comfort, the wounded man having his head toward the rear and his feet over the motor. When weather conditions require, he can be completely covered with a canvas top mounted on a rigid frame.

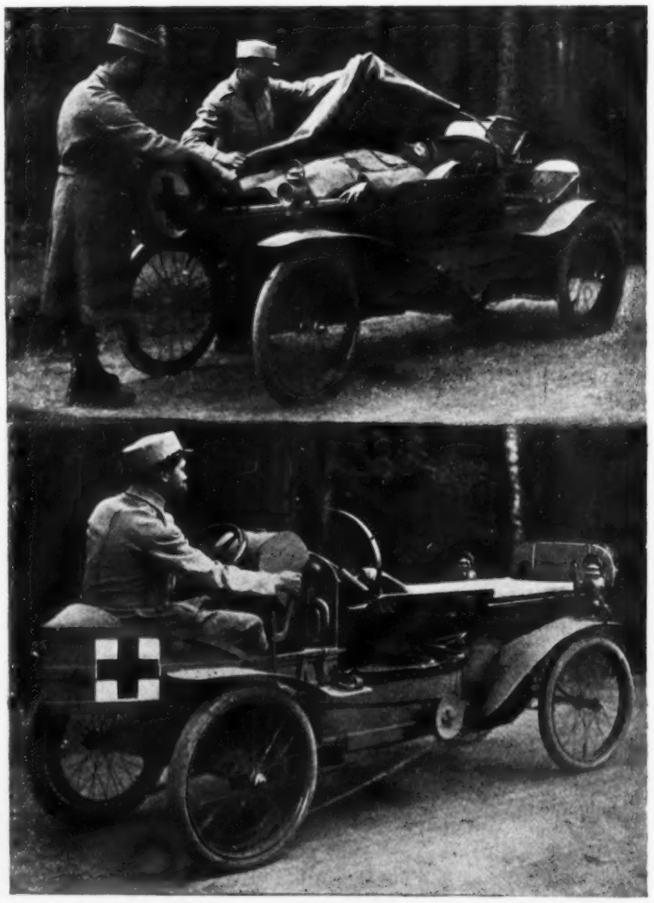
In the Vosges mountain district motorcycles and sidecars are made use of for bringing in wounded men from places inaccessible to the big automobile ambulances. On these mountain passes it is often necessary to travel over mule tracks where there is not sufficient width for an automobile and where the soft earth would not carry their weight. The motorcycles do this work efficiently. Although not an easy matter, means have been found to place a stretcher on the side car so as to handle serious cases.

To Increase Outputs

With a view to an increase of the output of all munition factories, the French artillery and munitions department has issued a circular showing how improvements can be made. These suggested reforms interest the automobile industry, for all the automobile factories of France are occupied on war material.

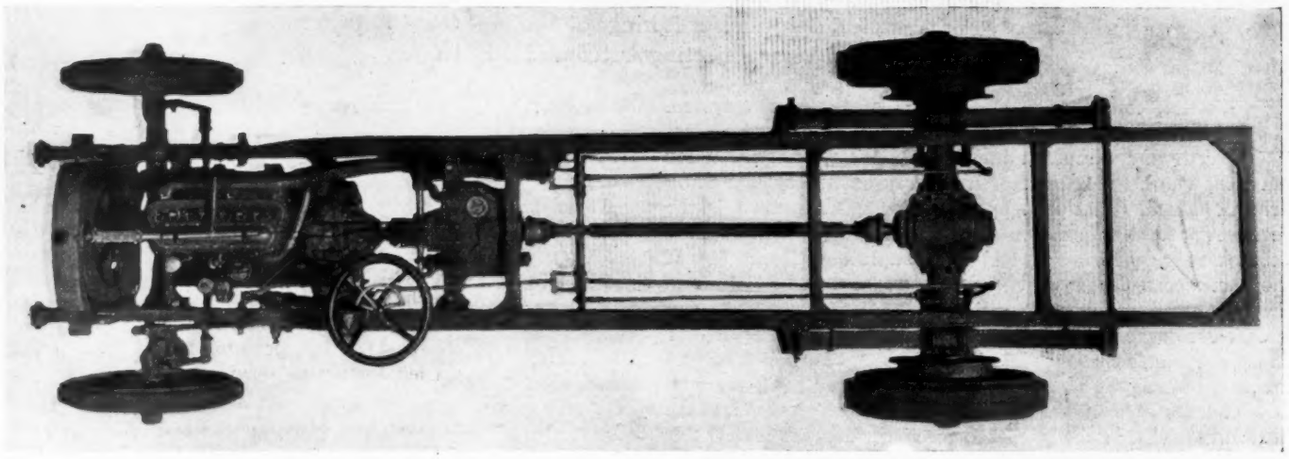
It is suggested that the Taylor system should be adopted as extensively as possible. This system is well known to French automobile manufacturers; when first attempts were made to adopt it, a few years ago, it met with opposition from the workers. Arrangements are now being made to place foreign labor at the disposal of the factories. It is suggested that this should be taken advantage of as fully as possible and that female labor should be employed. In certain special cases where new contracts are being given in France, one of the clauses is that no native labor shall be employed. No source of labor must be neglected, and every effort must be made to see that each man is doing the work for which he is best suited. If a man with military obligations cannot be employed to the best of his powers, he should be returned for active service in the army.

No automobile factories were able to produce forged shells until the war had been in progress for a considerable time. The installation of underground trolleys, endless traveling bands and light automobiles for moving shells from one part of the building to another, is also recommended as a saving of labor. In a large number of factories apprenticeship classes have been formed. While it is not expected that these will turn out highly skilled workers, the movement is to be recommended.



Above—Bringing in a wounded soldier on a cyclecar ambulance
Below—Showing control and driver's seat. Note belt drive

Kissel Brings Out New Two-Tonner



Plan of Kissel Two-Tonner chassis, showing the simplicity of the design and the substantial character of the various units

New Model Has a Four-Cylinder Block Motor 4¼ by 5½—Four-Speed Gearbox and Worm Drive Features

THE Kissel Two-Tonner recently announced by the Kissel Motor Car Co., Hartford, Wis., incorporates a number of improvements in design and construction over the preceding model of the same capacity, and the chassis sells for $1,875, or a reduction of $235. Specifications of the new model follow closely those of the previous 2-ton machine, the truck being a worm-drive, left-steer machine.

36.75 Hp. at 1200 R p.m.

A four-cylinder block cast motor of 4¼ in. bore and 5½ in. stroke and built in the Kissel factory is used, and is claimed to develop a brake test horsepower of 36.75 at 1200 r.p.m. The formula rating is 28.9 hp. The power plant drives through a leather-faced cone clutch, fitted with adjustable springs to insure gradual engagement with the flywheel, a four-speed selective gearbox, double Spicer universal and shaft to the worm and wheel rear axle.

The gray iron crankcase casting is divided on a line 2 in. below the crankshaft center, and is designed to insure great resistance to strains of all kinds. The crankshaft is drop-forged from 40 per cent carbon steel, and is suspended in three bearings constructed of babbitt poured into a steel skeleton. The camshaft, also suspended in reinforced babbitt bearings, is an integral forging. Wristpins are of 1⅛ in. diameter and are made of Shelby steel tubing, hardened and ground, working in Non-Gran bearings in the connecting-rods.

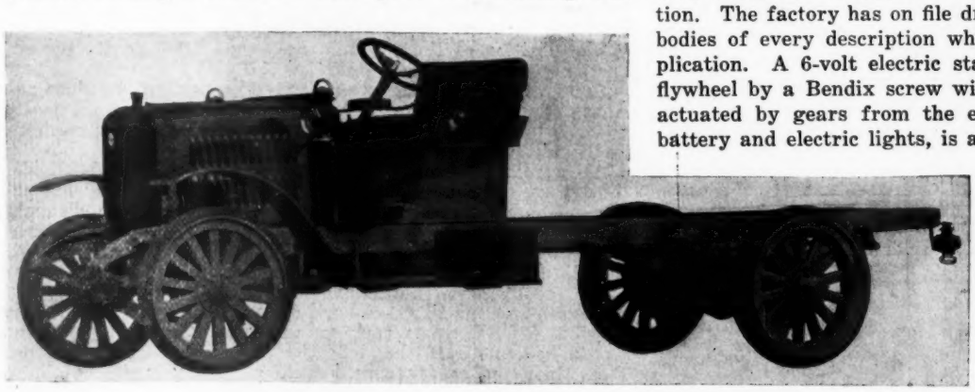
The motor is oiled by a splash system in combination with a positive action gear pump which forces oil through tubes to troughs under each of the connecting-rods. The carbureter is manufactured in accordance with Kissel design by Stromberg, and receives fuel from a Stewart-Warner vacuum tank which is attached to the motor.

The radiator is of the square tube type hung in a spring-suspended cradle designed to prevent weave and vibration on the radiator when traveling over rough roads. Cooling is by centrifugal pump circulation, with a water capacity of 5 gal. Maximum speeds are automatically regulated by a governor on the motor, which allows a maximum engine speed of 1295 r.p.m., permitting the truck to travel 14 m.p.h. on direct drive, 16 on fourth, 8 on second, and 4 on low. The wheelbase is 144 in. and the sizes of the solid rubber tires in the standard equipment are 34 by 3½ in. front and 36 by 6 in. rear.

The frame is of pressed steel 6 in. deep, ¼ in. gage, 34 in. wide and is suspended on semi-elliptical alloy steel springs measuring 38 by 2½ in. front and 54 by 3 rear.

Timken axles are used, the rear axle being floating with worm drive inclosed in a steel-cast housing. A turning radius of 25 ft. is obtained.

A standard stake body, painted Kissel blue with black chassis is furnished for $150 additional, or special bodies with increased wheelbase or length of frame upon specification. The factory has on file drawings and prices for special bodies of every description which may be secured upon application. A 6-volt electric starting motor driven from the flywheel by a Bendix screw with a 6-volt lighting generator actuated by gears from the engine, complete with storage battery and electric lights, is also offered at $150 additional.



The new Kissel Two-Tonner chassis selling for $1,875. Standard equipment includes two oil lamps, tail lamp, horn, jack, complete set of tools and steel channel bumper. Stake body is $150 extra

Adjustable Fulcrum for Cantilever Springs

Theory and Practical Solution for Springs of Variable Flexibility from the Point of View Rejecting Automatic Adjustment

DESIGN, construction and theory of the North system for varying the flexibility of cantilever springs are set forth and discussed in *The Automobile Engineer* for May, the views which led North to work out the system being first explained. With reference to practical results it is the reviewer's total impression that the subject which is here debated may be formulated in two simple questions: (1) If the anchored end of a cantilever spring is 30 inches long and the axle end is 24 inches long, or in similar proportions, can a considerable change in the flexibility of such a spring be effected by an adjustment which makes the anchored end 24 inches long and the free end 30 inches long, and will there be any unacceptable stresses due to adjustment for maximum flexibility? (2) Is the proposed mechanical arrangement for effecting such an adjustment adequate and acceptable?

The main points in the presentation of the subject are given in the following:

Objects and Requirements of the Construction

While the need for adjustability of the suspension is not great in large and heavy cars, where the load variation is relatively small, the increase of average comfort which results from adjustability of the suspension is very great in light touring cars, which may weigh only one ton and may carry loads varying from 200 to 1500 pounds.

It is useful to have an adjustment of sufficient range to cover the variation in weight of different styles of body mounted upon the same kind of chassis, and such an adjustment also meets the requirements for a vehicle which is used as a sporting car in the country, in which case stiffer springs than standard are needed, and also as a town car, for which purpose a very flexible springing is more suitable.

An adjustable spring should not weigh more than a non-adjustable spring of a capacity equal to its maximum. This is important to keep the total weight of the car down and practically excludes any device which stiffens a spring by clamping a portion of it down. Such a spring must either be very heavy or else it is overstressed when the work is severe. Similarly, it should be impossible to overstress material by incorrect adjustment.

Against Automatic Adjustment

Experience has shown, and theoretical considerations also indicate, that a spring which automatically becomes stiffer when the load is increased is not on the average as comfortable to ride on as the ordinary type. For instance, if the dead load deflection of a spring is 4½ inches, this may be momentarily increased to 7 inches or reduced to 2½ inches at high speeds. With a progressively-resisting spring, such a deflection of 7 inches would be reduced while the rebound would be increased, and the comfort would be lessened, the spring being evidently incapable of differentiating between an addition to the dead load and a brickbat lying in the track of the wheels.

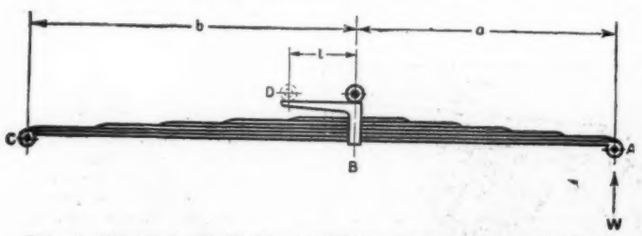


Fig. 1—Diagram of North cantilever spring with adjustable fulcrum

The following passage is quoted verbatim:

"For certain classes of vehicles in which the variations in loading are frequent and extreme, and where the driver cannot be expected to be continually adjusting the suspension, a 'compound' spring is of real advantage. Heavy motor lorries running on solid tyres form the best example of this class. The springs on a lorry have to absorb a great many of the small shocks set up by minor road inequalities, but in the case of a pleasure car these are smoothed out by the pneumatic tyres. These small shocks, causing small displacements of the axles, can be efficiently dealt with by a 'compound' spring, as the stiffness is approximately constant for movements of limited amplitude. At the same time it must be distinctly understood that even on a motor lorry a 'compound' spring will not give such smooth running as an ordinary spring of the correct stiffness for the particular load that happens to be on the vehicle at the time."

[These passages give the usually accepted argument against springs having a decreasing rate of flexibility with increasing deflection, and therefore the main argument for electing to vary the flexibility by adjustment. It may be shown, however, that this argument loses in force if suitable rebound checks are employed and the range of action for the spring is fairly ample. This opposite view, on the subject of springs with variable flexibility, will be briefly presented and illustrated another week.—M. C. K.]

The North adjustable cantilever spring has a uniform stiffness over the whole range of its deflection with a given setting. By a simple operation, taking a few seconds only, the stiffness can be altered to any desired degree within the limits provided for; and these can be for touring cars 1.8 to 1 or even 2 to 1.

The mathematical demonstration runs as follows, comment by the reviewer being inserted in brackets:

For a spring having a given number of leaves of equal thickness and stepped off evenly to the ends, the deflection of one end under a given load applied at the end is proportional to the cube of its length, therefore denoting the length AB by a and length BC by b; and, assuming that the deflection of the portion AB under a load W applied at A is x, then the deflection of the portion BC under a load W applied at C would be $x\left(\frac{b}{a}\right)^3$. It will be observed that we are now considering the spring as two separate portions, and this must be borne in mind throughout. Any alteration in the position of the fulcrum makes no difference to the deflection under load of the portion AB.

[This assumption seems unsafe. The portion AB does not exist separately when the fulcrum is moved from vertically above B toward D. The arrangement provides a new mechanical condition in which the fact that a point directly above B WAS a fulcrum is of no consequence. Also, to CONSIDER the spring as two separate portions does not justify mathematical deductions for a spring that IS NOT in two separate portions. Further, as is done in the rest of the demonstration, to figure the reaction at C from the load-action at A, calculate the deflection which this reaction WOULD cause at C if C could move (downward), and then from this supposed deflection assume that the bending movement of CB which is possible MUST cause such an additional deflection at A as would be caused if the deflection of C were real, does not seem like self-evident mathematical reasoning (though it

When the adjustment is set for the heaviest load, the fulcrum is on the center line of the clip, and the behavior is that of an ordinary cantilever spring. The thickness, width and number of leaves are calculated for this position, and the maximum stress for any other setting cannot exceed the maximum calculated for the "stiff" position. The requirement is therefore met that the spring shall be no heavier than a non-adjustable spring for the same maximum load.

By providing bumpers, the second requirement is met; namely, that the spring cannot be overstressed by incorrect adjustment.

Below there is given a mathematical investigation of the properties of the system, the latter being represented diagrammatically in Fig. 1. The width of the clip is, however, disregarded, this causing an error of 1½ to 2 per cent only for a clip of small width, as shown, and springs of the preferred length.

Most Suitable Length of Springs

With regard to the length of the spring and the relative lengths of its two portions, it is noted that so long as the proportions in these dimensions are the same the variations produced by adjustment will be identical. In the example calculated below, AB is 24 inches and BC 30, and a displacement of the fulcrum of 6 inches gives an increase of deflection of 80 per cent. Similarly a displacement of the fulcrum of 3 inches would give 80 per cent of variation in flexibility if AB were 12 inches long and BC 15 inches long. Such a shorter spring could be made to do the same work as the longer one, but would have thinner leaves and a great many more of them, since the weight of the short spring would have to be the same as for a longer one (to do the same work without increased fiber stress) and, the leaves being so thin, the spring eyes would be weak and liable to fracture. Moreover, it is more expensive to work up, say, 20 thin and short leaves than 5 leaves twice as thick and long and of the same width. Other objections to very short springs are that, for the same initial camber, the curvature of the short spring when unloaded must be much sharper, and the horizontal displacement of the rear eye, as it is deflected, is much greater. This means a larger angular movement and wear of pins and bushes as well as troubles in using the springs for taking braking or driving thrusts. Particularly for an adjustable spring there is an objection to the very short springs in that the fulcrum would be situated in an inaccessible position behind the wheel.

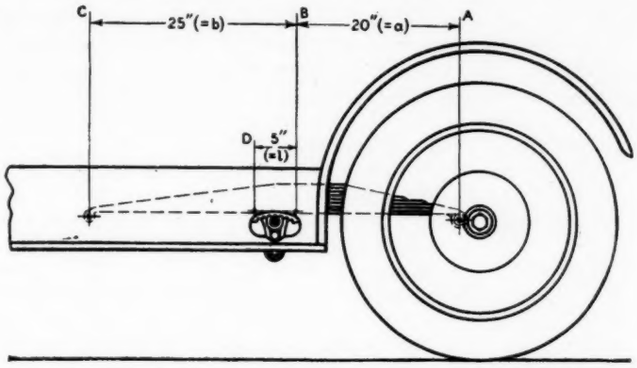


Fig. 2—General arrangement of construction shown in Figs. 3 and 4

The main objection to very long springs is that the displacement of the fulcrum for a given variation in stiffness would be increased, making the adjustment device heavy and clumsy. On general grounds, a very low spring is either unnecessarily heavy or must consist of a few thick leaves.

As small cars do not require much shorter springs than a large car, if equal deflections and equal comfort are to be obtained, the proportions of the adjustment device can be almost alike for all.

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may be approximately correct in practice), but is on the contrary a fine example of *petitio principii*, or reasoning in a circle, against which all logicians and authorities on mathematics have warned us.]

A load W applied at A causes a deflection x of the portion AB. When the fulcrum is at B, the load W at A sets up a vertical reaction at C equal to $W\frac{AB}{BC}$ or $W\frac{a}{b}$.

The deflection of the portion BC under this reaction is

$$\frac{W\frac{a}{b}}{W}\cdot x\left(\frac{b}{a}\right)^3=\frac{a}{b}\cdot x\left(\frac{b}{a}\right)^3=x\left(\frac{b}{a}\right)^2$$

Now, the deflection of the portion CB does not manifest itself as an upward movement of point C, but as an angular displacement of the clip round the fulcrum at B.

This causes an upward displacement of point A additional to that caused by the deflection of the portion AB.

The upward displacement of A due to deflection of portion CB is [objected to, above]:

$$\text{(deflection of } CB \text{ at } C)\ x\frac{a}{b}=x\left(\frac{b}{a}\right)^2\cdot\frac{a}{b}=x\frac{b}{a}.$$

The total deflection of the spring for a load W applied at A is therefore:

$$x+x\frac{b}{a}=x\left(1+\frac{b}{a}\right)$$

Behavior of Spring Adjusted to Higher Flexibility

Let D indicate the new position of the fulcrum (Fig. 1), and let this point be at a distance l from B.

Then for a load W applied at A the deflection of the portion AB is the same as before [objected to, above], *i.e.* $= x$.

But the reaction at C is changed owing to the altered position of the fulcrum. Taking moments about the new fulcrum point [which, however is a new kind of fulcrum, when flexions of the beam are the main consideration] we get:

$$\text{Reaction at } C=W\frac{AD}{DC}=W\frac{a+l}{b-l}$$

Hence the deflection of portion CB measured at C will be

$$\frac{W\frac{a+l}{b-l}}{W}\cdot x\left(\frac{b}{a}\right)^3=x\frac{a+l}{b-l}\cdot\left(\frac{b}{a}\right)^3$$

And the upward displacement of A due to deflection of portion CB

$$=x\frac{a+l}{b-l}\cdot\left(\frac{b}{a}\right)^3\cdot\frac{a+l}{b-l}$$

And total deflection of spring

$$=x\left(1+\frac{(a+l)^2}{(b-l)^2}\left(\frac{b}{a}\right)^3\right)$$

And the ratio of the deflections for the two settings

$$=\frac{1+\frac{b}{a}}{1+\frac{(a+l)^2}{(b-l)^2}\cdot\left(\frac{b}{a}\right)^3}$$

Example in Figures

Taking an actual example, let us suppose a spring in which $a=24$ inches, $b=30$ inches, $l=6$ inches (in the position of greatest flexibility). Then the ratio of the least and greatest deflections will be:

$$\frac{1+\frac{30}{24}}{1+\left(\frac{30}{24}\right)^2\cdot\left(\frac{30}{24}\right)^3}=\frac{2.25}{1+\left(\frac{30}{24}\right)^5}=\frac{2.25}{4.052}$$

that is, the deflection for a given load when the adjustment is set for maximum flexibility is 1.8 times that obtained with the adjustment at its stiffest.

[There follows in the original a similar mathematical demonstration with regard to the stresses at the two settings, but it rests on the same assumptions as are employed above and is therefore here omitted, so much more as it seems evident in advance that the stresses in the lengthened free end of the spring must be lowered, and also that the reactions from them upon the shortened anchored end cannot be much greater than those to which the short free end is exposed at the stiffest setting].

An almost infinite number of methods can be used for effecting a displacement of the fulcrum. One of the first designs was based on the arrangement indicated in Fig. 1. A roller turning on ball bearings formed the fulcrum of the spring, and the pin on which the roller turned was carried in a bracket with a longitudinal slot on each side of the spring leaves. The pin was formed with knuckle teeth at each end, and these engaged with rack teeth cast on the upper side of the slots. By applying a box spanner to the hexagon end of the pin it could be rotated and moved along the racks. A spring-loaded clip was provided to prevent accidental displacement of the pin when the load was momentarily removed from the spring, and pads, suitably lubricated, were arranged to take the lateral forces acting on the spring. But this arrangement was costly and had a clumsy appearance.

The final design is illustrated in Figs. 3 and 4, while Fig. 5 shows the actual adjustment mechanism provided for a Straker-Squire ambulance used by the London Asylums Board. Fig. 4, it will be noticed, shows the dimensions of only 20 and 25 inches for the two portions of the cantilever spring and a displacement of 5 inches. A quadrant A is clipped to the spring by setscrews or wedges and is gripped by the two grooved lugs B and C, the latter being integral with shackle pin D, which passes through B and also through the shackle E, which turns on a trunnion F. The curved rails of the quadrant are struck with F for center.

The forward end of the spring is anchored to the frame, and when the shackle E is in an oblique position the horizontal component of the diagonal reaction along DF appears as a thrust or pull, as the case may be, along the lower leaf of the spring. The virtual center about which the spring may be said to turn is situated at the point where DF prolonged meets the neutral axis of the bottom leaf of the spring, which is assumed to be flat in the mean position. Thus when GH=5 inches the displacement of the fulcrum is 5 inches between the two extremes.

In order to prevent the clips from slipping along the quadrant, they are drawn together by the nut I, which when tightened up forces the clip B along the pin.

As a safeguard against forgetfulness, a collar J is screwed and pinned to D immediately behind the nut I, so that if the driver omits to tighten up the latter nor harm can be done since the nut and the clip B cannot slack more than 1/32 of an inch.

When adjusting the spring a special spanner K is used. It has keyways broached in it, and these engage with the castellated exterior of the nut I, which is slacked back half a turn or so. The spanner is then pushed further in, disengaging itself from the nut. A series of teeth cut on the boss of the spanner then engage with internal teeth cut in the edge of the stamping L, which it attached to the quadrant casting, and forms a dust cover for the curved guide strips.

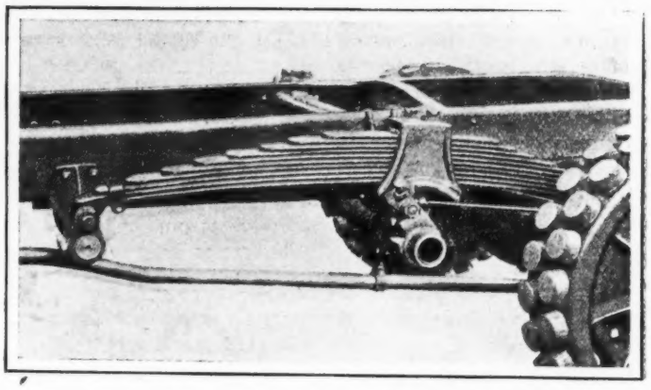


Fig. 5—North spring applied to ambulance chassis

The boss of the spanner then acts as a pinion engaging a rack, and, since a leverage of about 4 to 1 is provided, a spanner 11 inches long is amply sufficient to move the clips along the quadrant, even when the springs are carrying a load of 1,600 to 1,700 pounds.

After moving the clips to the desired position the spanner is withdrawn from the rack, and is engaged with the nut again; this is tightened up, and the spanner then withdrawn completely.

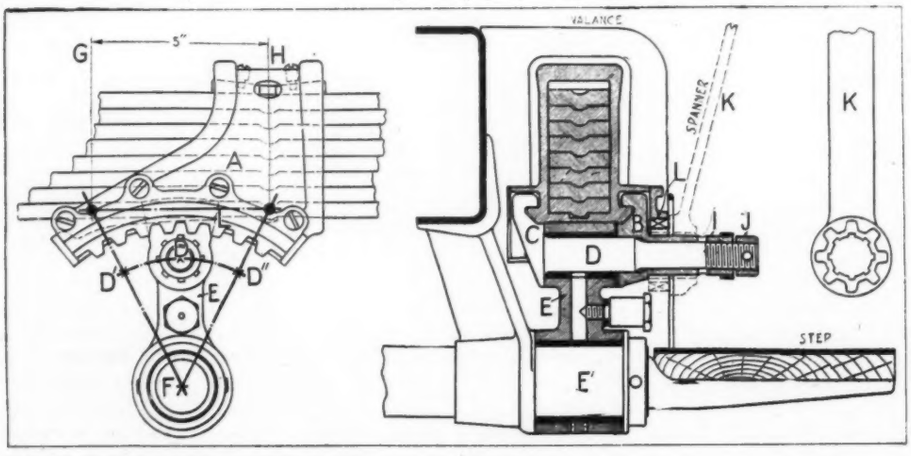
The design here described is a slight improvement on the design illustrated in Fig 5. Here a long lever acting directly on the link was used to adjust the spring, a construction which would be inadmissible on a touring car, owing to the position of the running boards.

The springs fitted to the Asylums Board ambulance were designed to take a maximum load of 2,800 pounds, which is, of course, very much more than the springs of the average touring car have to carry. The design in Figs. 3 and 4 is for a medium weight five-seated car, and the drawings are to scale. The springs are calculated for a load of 1,700 pounds maximum, and have an adjustment ratio of 1.8 to 1.

Paragraphs on Current Topics

By Marius C. Krarup

Motto: Radical Thought, Conservative Action.



Figs. 3 and 4—Final construction of North adjustable fulcrum for cantilever springs

Motorized is Mobilized. Which accounts for the legend that Paris taxicabs saved the Marne. They didn't, but they contributed.

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"Americans think through their interests," said the late Professor Gunter, not quite in reproof. Such thinking is more reliable and to the point, when it is finally pooled from all sides, than academic idealism in behalf of the supposed interests of all. With this preface, the automobile industry can afford to admit, if so disposed, that Preparedness on land, and largely by motor power, looks more attractive and necessary than a navy

just big enough to get decisively licked under adverse conditions; and nothing bigger or better has been proposed. The best logic for all is on the same side as the interests of the automobile industry.

□□□□□

To repeat and amplify: A great invincible navy for an empire of islands and colonies, which can keep it busy and modern. But for this continental republic, mainly a motorized army and navy staff of 100,000 officers and engineers, all of them practical and working scientists; a motorized people of gunners and mechanics owning a fair share of the soil and civilization for which they may be asked to fight. Fifty more paragraphs on these lines would make a program for a self-supporting, profitable and efficient preparedness made to measure for Uncle Sam, but unfortunately common opinion accepts more readily the hackneyed idea which sums up the requirements as "a few more battle cruisers and super-dreadnoughts, more aeroplanes, more soldiers, more militia, more coast defense ordnance, more summer training in bivouac, more industrial organization for rapid production of munitions and ammunition." This amateurish hodge-podge of good and bad spells militarism without efficiency, bluff without a punch behind it, cost without returns. Automobile manufacturers, the best trained all-around thinkers in the world of to-day, can lend their voices to something far better, by organized effort, and the incidental advantages for the industry should not close their mouths in modesty, considering especially that those who are licensed to speak most loudly on the subject, with the megaphone voice of the daily press, have less special competence.

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Frank Crane, D.D., of the New York *Globe*, has found 72 unfamiliar words, more or less closely related to automobiles, and he presents them to his public in wonderment, and for wonderment. Will somebody be kind enough to send him one of the many automobile glossaries, for reviewing? He is short 3000 or 4000 perfectly good words in his accounts. If he is clever, he can then discourse upon the hollowness of the knowledge which is familiar with even all of these words, but not with the things and the laws which they represent. Wordless engineering is a fascinating theme which still awaits a sympathetic and capable interpreter, though it peeps out from unmentioned shapes, dimensions, proportions, dispositions and omissions in every manufactured thing of complex mechanical organization.

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As soon as the rear drive is placed in the frame of the chassis, on some plan such as De Dion's, Jakobsen's or Christie's, the allowable 6-inch amplitude of spring deflection, for touring cars, is suddenly doubled without raising the height of seats—even if a plain axle remains to connect the wheels—and the main industrial hindrance to improvement of spring suspensions is removed. Some car owners remove this hindrance more nonchalantly by disregarding it when fitting auxiliary spring appliances; in all of which there is any moral that one chooses to deduce from it.

□□□□□

Were a little unknown experimenter to produce an aeroplane of modest dimensions, equipped with a motor of no extraordinary power, reliability or lightness, and his unpretentious craft could fly no faster than 50 m.p.h. in calm weather but could start from the ground at a standstill or with a five foot run, could start from a ship without the aid of a catapult, and could hover in the air over any given spot of the earth, or could come near doing this, it would not be guilty of breaking any laws of man or nature, but it would be the greatest and most sensational and epoch-making thing that has yet appeared in aeronautics, aerostatics or aerodynamics. On the other hand it would not have the shadow of a chance for competing and winning in the great contest for aeroplanes which is to take place in this country in September and for which valuable prizes and trophies are offered. The event is framed to stimulate progress on obvious and imitative lines only. And, for a beginning, this may be the part of wisdom. But soon better may be done, for aviation motors and automobile motors are converging more and more toward the same ideal, automobile builders are becoming interested in aviation, and, this done, it should not take them long to discover that there is room for systematic experimentation with some of the fundamentals in aviation. Then for real progress and contests bearing on those points in design which are not yet popularized and do not take care of themselves.

□□□□□

We are intent on selling cars to ourselves just now and glory in the hustling activities of the dealers, but the deeper current of thought is a resolve to make and sell cars and motor trucks to the world at large ever hereafter, and all leaders have realized that, to reach this pinnacle of commercial accomplishment, we must create an unshakable foundation for our industrial advantages. Dr. Fleming has stirred England to appreciate the need of organizing science to co-operate with industry and of ceasing to rely on foreign research work. On a similar plan, since the automobile industry roots deeply and broadly in the scientific work concerned with the production of its raw materials, the American automobile industry could afford to take in hand a hundred vigorous and promising young chaps and give them the most thorough scientific and practical schooling in all sorts of knowledge ultimately bearing on design, construction, production and world-marketing of motor vehicles and agricultural tractors. Supposing it cost $200,000 per year for seven years! The world will probably stand that long, and the cost would come back whether the acquired knowledge would have to be bought from its new possessors at the market price or not.

□□□□□

In Italy, automobiles are now prohibited from approaching within several miles of the Swiss frontier. In this manner the frontier itself can be watched and guarded most effectively. Here an analogy suggests itself in connection with the expansion of professional work which will be necessary to strengthen the hold of American industry in the markets of the world. Such work should be singularly free from deception and trickery. If we guarded the approaches to our professions, by insisting on cultural requirements extending back to boyhood and wholly of record, not only crimes *à la* Dr. Waite and the similar ones which escape detection but also multitudes of minor slips from grace, would be less liable to occur. Preparatory education in set forms sifts out the unsafe characters and protects the public and employers better than mere final examinations and diplomas.

□□□□□

As to that mooted distinction between invention and new construction, there is a new version: Inventors create inducements for departing from current practice, while constructors create new inducements for adhering to it. In either case, full knowledge of current practice would seem to be at a premium.

□□□□□

A national subscription to defray the cost of advertising Electric Lighting is under way, the medium proposed being the Statue of Liberty in New York's harbor. An excellent and business-like plan! A huge new companion statue, in steel and armored cement, representing the "Internal Combustion Motor Moving the World" might also be in order; with self-starter accessory conspicuously displayed on the pedestal.

Factors in Universal Joint Design*

Part II

Type with Independent Case Worked Well in Experiments but Was Clumsy and Awkward To Assemble—A Review of European Designs—Future Possibilities

By A. Ludlow Clayden

*Paper read at Cleveland section S.A.E. meeting, May 19.

IN independent case designs the case was supplied with oil from the gearset and the mouth of the case was closed by a leather tube having a slip ring which was a free fit on the shaft. The device worked very well, but it was clumsy, heavy and very awkward in assembly. There was also some trouble to insure sufficient oil without permitting the passage of too much. A modification which resulted in considerable improvement was to abandon the oil feed from the gearbox and substitute a copper pipe leading to an oil cup on the side of the chassis frame. This provided an easy way to charge the case with oil, but the user of the car still had no way of telling whether he was putting in enough till it began to overflow.

Some European Types

It is perhaps interesting to examine some of the typical European joint designs very briefly.

One of the most difficult types of universal to make so that it will be satisfactory under all conditions, is that which includes a sliding joint. Probably the originators of the combined universal and telescopic coupling were the DeDion company who were compelled to use a joint of this nature in connection with their axle. The old DeDion cars had the transmission and differential in a unit which was attached to the rear of the frame. The wheels were carried on a tubular axle which was slightly dropped, and the drive from the sprung differential to the wheels was made by a pair of short propeller shafts with universal joints at each end. For this purpose the familiar type of cylindrical outer casing was used, this having two deep grooves internally: The shaft had a cross pin on which were fitted square nuts of phosphor bronze, free to turn on the pin and with the tops rounded. There is a fundamental difficulty in lubricating this type of joint with grease, this being the pumping action which tends to pull the lubricant outward. The difficulty can be overcome by careful inclosure and a great many ingenious devices have been evolved with this end in view.

Another drawback to a joint of this design is the double wearing surface. There is opportunity for looseness to develop between the sliding nuts and the outer case, while wear also takes place on the pin and on the bore of the nut which bears against the pin. This gives no trouble, however, if the parts are made of the right material and if the mounting is such that the telescopic action is not excessive.

An alternative design which is very greatly used both in America and abroad is the spline coupling where one end of the propeller shaft is splined and the fork of the universal joint at that end grooved to correspond. This makes a very good telescopic joint if there is ample length of bearing but,

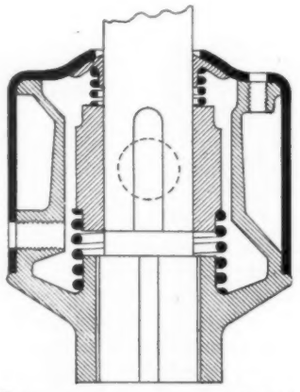


Fig. 10—A neat method for inclosing a joint of the De Dion pattern

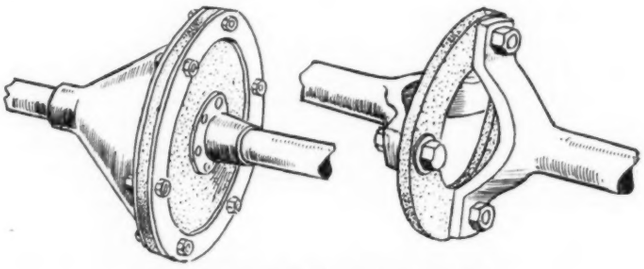


Fig. 12—Two varieties of leather coupling. Left—The original which stressed the leather highly, and Right—The modern design in which there is only direct tension on the leather

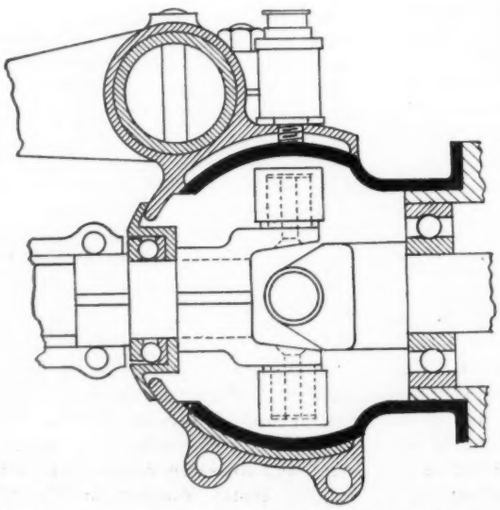


Fig. 11—A typical ball joint inclosure at the front end of a torque tube

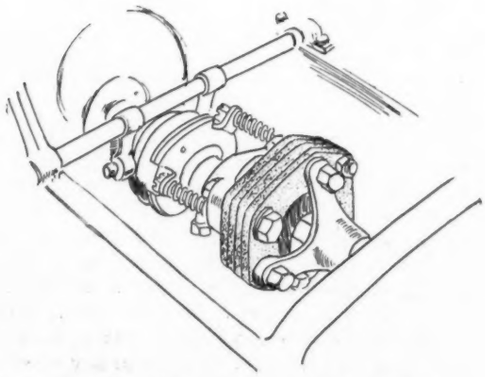


Fig. 13—Leather joint used on the Jeffery car between the clutch and gearbox

owing to the necessarily small radius, it requires no calculation to show that the pressure on the surface is very high. If ample length is not provided it will be impossible to retain grease between the splines and as soon as the lubricant is squeezed out wear will be very rapid.

At the present time there seems every reason to believe that the Hotchkiss drive will shortly be conventional practice and attention may be drawn to the fact that a rear spring which is normally nearly flat provides the ideal form for Hotchkiss drive from the viewpoint of universal joints; since with a flat spring the fore and aft movement of the rear axle will be at a minimum. There are some designs in which the amount of slide on the universal joint from one extreme of spring motion to the other is less than half an inch. This means that in ordinary running the movement is so slight as to be almost negligible.

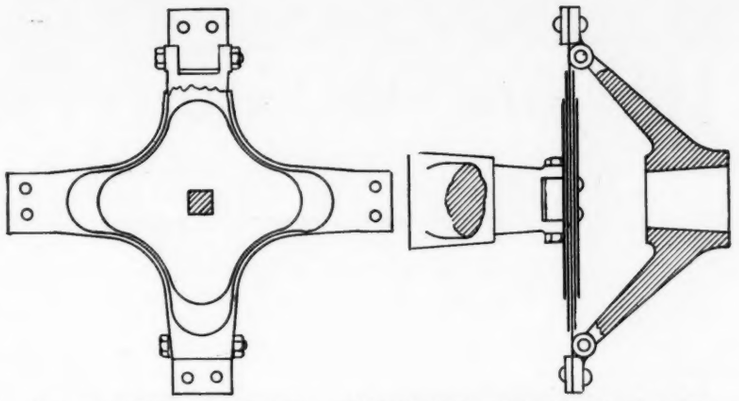


Fig. 14—Patented design for a universal joint made entirely of spring steel. The center leaf with shackled end takes all the drive, the other plates being added to stiffen the whole

A rather curious type of telescopic joints, shown in Fig. 4, has been used considerably on British commercial vehicles with better durability than the DeDion type of sliding joint. This consists of a small pinion on the end of the propeller shaft having the tops of the teeth cut to a curve with the center of the pinion as radius. The teeth slide in grooves cut in a cylinder case which is attached to the final drive pinion just like the outer part of the DeDion joint. It is claimed that this design allows a larger area with less weight, and it also eliminates the necessity for the cross pin used to carry the nuts in the DeDion joint.

A very different type of combined universal and sliding joint which is still used on the Lanchester car is the simplest of all. In this the end of the propeller shaft carries a block of steel about 3 in. square in end elevation. The block is about 1¼ in. wide and the edges are all curved. On the gear shaft is a steel cup of square section into which the block on the end of the propeller shaft fits snugly. Unless very carefully made it is almost impossible to eliminate rattle from this type of joint but, as made by the Lanchester company, it has been very successful and has been adhered to by that concern for nearly 10 years. See Fig. 5.

There have been many freak universal joints, some of which possess special merit. One, used by several British firms, notably the Rover company, is illustrated in Fig. 6. As will be seen, there are two flat forks and connection between them is made by a steel ball with two grooves cut in at right angles. This same joint was used in one instance for driving an overhead camshaft, where its facility for being taken apart is advantageous. It is a joint permitting very neat inclosure but it is rather difficult to keep down the bearing pressures without using large and heavy parts in its construction.

In Fig. 7 is shown a joint which has been used by the Wolseley company for some 7 or 8 years. The outer ring is split transversely and each of the pins is bushed. Thin grease or heavy oil can be supplied through a screw in the outer case and it will be noticed that the universal ring is integral with the cap. A more usual construction for what is commonly called a ring joint, is shown in Fig. 8, this being typical of a great many continental designs. Here the ring is split in a horizontal plane and it is not usual to find this type of ring made integral with any part of the inclosure.

With Stationary Cover

Fig. 9 shows the inclosing scheme adopted for a well-known British car which is an example of the stationary type of cover. This differs somewhat from the stationary case described previously, in that the brass cone seen on the propeller shaft is fixed to the latter and there is no connection between it and the stationary brass case inclosing the joint. The purpose of the part on the propeller shaft is to protect the opening to the main case. This eliminates the necessity for a slip ring on the propeller shaft and has worked out very well in practice, the cone protecting the opening into the main case sufficiently to exclude practically all dirt and water.

Fig. 10 shows a rather ingenious way of inclosing a DeDion type of telescopic joint. This idea has been developed in many different ways, the illustration being taken from a drawing of a British light car.

The Need of Compromise

The consideration of universal joints, and their inclosure, shows up the need for compromise so often found in automobile construction. From the viewpoint of the universal joint there is no better inclosure than is provided by a torque tube with a single joint at the front end of the propeller shaft contained within a spherical housing formed on the end of the torque tube and set into a corresponding socket on the back of the gearbox. A construction of this sort, as Fig. 11, allows copious lubrication from the gearset and, in practice, appears to insure an almost everlasting universal if all the details are carried out well.

Against this design, however, we have the velocity variations caused by the action of a single joint, and we also have the weight and cost of the torque tube construction. At present it appears that the simplicity and lightness of the Hotchkiss drive, or at least of a double jointed shaft with a light torque stay, more than outweigh the better protection of the torque tube. There is no easy way of lubricating universals on an open type shaft except by periodical grease packing. Thus it is up to automobile designers to choose joints of such a size that they will not be overloaded and will contain a good supply of lubricant. Picking the smallest size of joint that the manufacturer will guarantee for the car is poor policy, as it means poor durability in any case and very poor service indeed if the owner of the car neglects to grease up frequently; and he usually neglects the universals more than any other point on the chassis.

Future of Flexible Material

A type of joint which has tempted inventors for ten years and more is that in which there is no bearing; no working surface whatever. Instead of a joint a sheet or ring of flexible material is employed, the natural elasticity of the substance being used to give the necessary movement.

The most common coupling of this sort is the leather disk so often used for driving magnetos or other engine accessories. Leather ring couplings like Fig. 12 are commonly used between the clutch and the gearset in European designs, and on some American cars, notably the Jeffery, Fig. 13, and they have been tried for the propeller shaft. There is at

present no American car with propeller shaft joints of this character, but there were several on the European market just before the war.

The heaviest service to which leather ring joints have ever been put is on the omnibuses in London. Owing to variations in the load the universals on an omnibus see heavy service and the noise of a worn pin joint is very objectionable. At first the leather joints seemed to be ideal. They lasted for a good many thousand miles, were cheap and more easy to replace and were always quite quiet. However, the latest advices from London are that the leather is being abandoned in favor of joints with ball bearing or roller bearing pins, as these appear to last forever without wear, maintaining the quietness of leather without the need for periodical renewal.

This is on very heavy service though, and it seems possible that we have not yet heard the last of flexible ring joints for passenger car transmission. Leather rings will take all the drive a passenger car engine can supply, and their drawback is mainly their liability to deterioration by the action of grease and water which slowly rot the material. To overcome this difficulty, disks are now being made of oilproof and waterproof substances like woven asbestos, and the trials are very encouraging, though it is early yet for predictions.

Yet another style which has never been developed to the full in actual practice is the joint which uses spring steel instead of leather or fabric. Such joints usually consist of a series of very thin spring steel rings clipped together and mounted exactly like a leather ring. In this form they have proved excellent for clutch couplings, but are probably no better than leather while being considerably more costly. Also a good large leather joint will permit sufficient end displacement to allow for clutch withdrawal without the provision of a metallic sliding joint, while the spring steel ring will hardly do this.

There have been several patents taken out for special designs using thin steel leaves to give freedom both axially and angularly, some of them appearing very promising on paper, but it is only hard service that can decide their merits and, if they are developed, it is likely to be in the future.

The purpose of this discussion is not to suggest that the universals we have to-day are other than excellent for their purpose. On the contrary, considering how bad universal joints were a short time ago and how little trouble they give in a modern car; and still more, considering the price at which they are sold, the modern joint of proprietary make is usually wonderfully good.

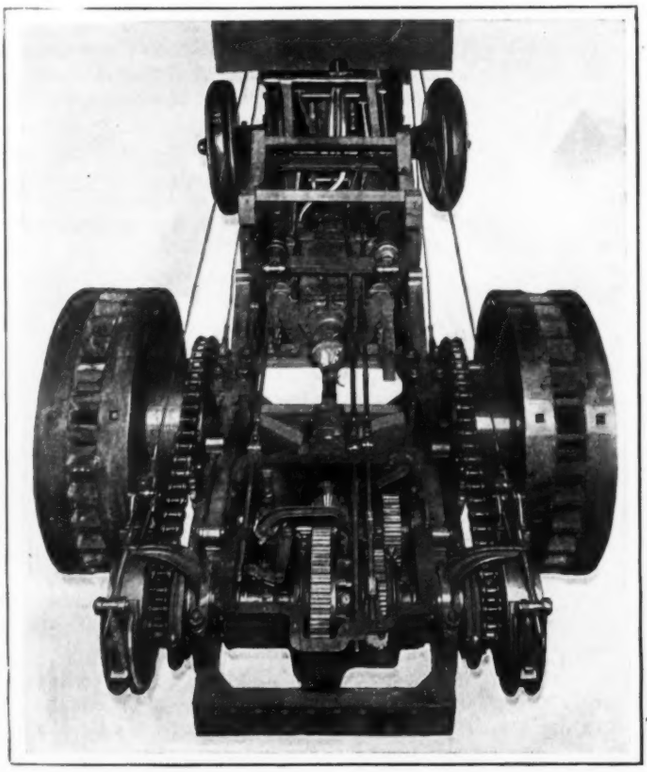
Like all other parts of an automobile, however, there is no reason to suppose that we shall *never* have anything better, and this brief examination of the subject will have served its purpose if it draws attention to some of the problems connected with the provision of an efficient, silent, and durable universal construction that will maintain itself without attention from the driver of the vehicle. It appears to the author that the American automobile engineer owes a great debt of gratitude to the specialists who have taken upon themselves the task of caring for a part of the chassis which has been quite troublesome to foreign engineers.

The Bulkley-Rider Road Locomotive

LOS ANGELES, CAL., May 27—The Bulkley-Rider Tractor Corp., this city, has perfected the Bulkley-Rider Road Locomotive, the tractor which the engineers of the corporation have been working on for more than 3 years.

The tractor is equipped with a 90-hp. Wisconsin motor. There is a first transmission and a reduction transmission, which is the foundation of the tractor. The road locomotive has six speeds forward, and when running in the unreduced high gear, has a speed of 20 m.p.h. When running in the reduced low, there is a total leverage of 96 to 1. Easy riding is secured by a double set of springs. The chassis springs are entirely independent of the load springs. All road shocks are provided for by these load springs and a pair of plungers which act as shock absorbers for all jars coming from the rear caused by ruts in the road. A winch is fitted which will pull a 28,000-lb. load on a cable at the speed of 70 ft. per min. With this equipment, the tractor can pull out of any hole or up the side of the steepest bank, pulling the load after it.

The tractor has a patent hydraulic jack which supports two extra wheels equipped with metal pedal pads. By releasing this jack, these wheels drop into place and the tractor becomes a four-wheel-drive machine.



Chassis of Bulkley-Rider Road Locomotive. Note strong construction

For service where the roads are fair or boulevards prevail, these extra wheels are not included in the equipment, but the regular wheels are equipped with patented paddle wheel rims which are detachable. When the tractor is to run on boulevards this metal paddle wheel is removed and replaced with the solid rubber tire.

The first of these Road Locomotives was built for the Yuma Consolidated Mines, Quartzsite, Ariz., and was recently accepted by officers of the company upon the showing made in its official trial trip which was for the purpose of demonstrating its pulling powers and general efficiency. This trip was from the harbor to the center of the city, a distance of 23 miles, a load of 45 tons being hauled with trailers. The entire trip was made in 2 hr. and 22 min.

It is claimed that this tractor will be of great service for military purposes as it is built for traveling over all sorts of ground and under all conditions and its weight is well distributed.

The FORVM

A CONSTRUCTION APPROACHING THE DIESEL ENGINE BUT SUITABLE FOR AUTOMOBILE PURPOSES AND EMPLOYING TO A DEGREE THE PRINCIPLE OF THE NAVAL GUN

Engine Utilizes Principle of Gradual Combustion

By James McIntosh

THE more I read J. E. Schipper's article on "Are Other Cycles Possible?" and notably in regard to the variable cutoff constant pressure means of control so am I convinced you agree with my theory; in fact, you so closely conform and the import of my patent claims seems to be in accord with your views that I have decided to disclose one phase that is covered but not hinted at in my specification, but well within the scope of my basic principle. Claim No. 2 of Patent No. 1,113,456 has this clause, "a valve" (broad term) "*for admitting air to the passage in position to precede a charge of mixture*, means for varying the quantity of air admitted." You will notice the "a valve" is not patentable as a valve or is the "means," as both are as old as the hills, but the function they perform is new. As to the italicized quotation there is no question as to what is meant. As to its application as a means of control, let us see what that means. I do not specify as to what volume the air must be, and the fact my claims refer to a means for varying the quantity of air I intend to use it as a means of control. Suppose I decide to call it a Volume Ratio control and decide to control the air only, and let that volume—be it large or small—determine what the charge is to be, let us consider pure air has no energy due to ignition and that a volume of mixture expands due to ignition 4 to 1, also that an equal volume of air and mixture at the point of contact has half that value, or 2 to 1. Assume that the total volume taken into the crankcase or pumping chamber is constant and at low speeds the volumetric filling will be more complete, this will tend to aid matters for light loads and also be beneficial in presenting pre-ignition with full loads.

Suppose I admit a 90 per cent volume of air (in position, etc.), the charge of mixture must be 10 per cent; again if the air be 10 per cent the mixture is 90 per cent. To better illustrate my point, I will assume 50 per cent of pure air is in position to precede a 50 per cent volume of constant mixture and at the point where the two volumes come in contact there is a 5 and 5 per cent combination.

Assuming Fig. 1, to represent the combustion chamber

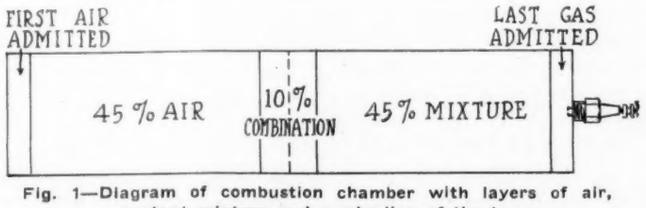


Fig. 1—Diagram of combustion chamber with layers of air, constant mixture and a mingling of the two

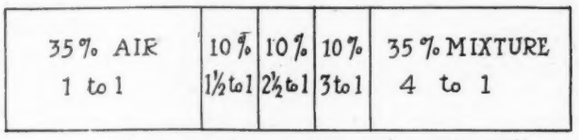


Fig. 2—With five layers of mixture, to fire in succession

and three layers with values, as above cited, the correct mixture and compression to be ideal for firing and the 10 per cent combination is too lean to ignite at the compression used we may expect after the mixture fires the rise in pressure and temperature will cause a second firing or we may assume there is a graded or tapering energy charge that will fire as the column heat and pressure rises, due to the correct mixture located at the spark plug. This is what I anticipate regardless of the volumes used. How far that eliminates initial shock due to a homogeneous charge fired instantly is very evident. As a means of control, assuming clean cut volumes, let us assume, say, three ratios:

%	%	%	%	%	%
90 of air.....	90	10 of air.....	10	50 of air.....	50
10 of mixture..	40	90 of mixture..	360	50 of mixture..	200
100	130	100	370	100	250

As a matter of interest let us take the 50 per cent and 50 per cent fired progressively in two distinct explosions:

%	%	%	%
45 air.....	45	45 air.....	45
10 compression....	10	10 compression....	20
45 mixture.....180		45 mixture.....180	
100	235	100	245

Again assume five layers as below and the first to fire the second, second the third, third the fourth and the fifth to retain its volume only.

First	Second	Third	Final Volume
35- 35	35- 35	35- 35	35- 35
10- 10	10- 10	10- 10	10- 15
10- 10	10- 10	10- 25	10- 25
10- 10	10- 30	10- 30	10- 30
35-140	35-140	35-140	35-140
100-205	100-225	100-240	100-245

This condition may be expected in action, although I do not care to predict just how many distinct impulses occur. I prefer to assume there is a gradual increase in pressure which will eliminate initial shocks on a crankpin and the increase in volume will act as a follow-up, the piston effect resolving into a flatted peak on an indicator diagram and approaching that of an engine using a constant pressure cycle and similar in action to that of a Diesel engine where the fuel is injected and time elapses before the full charge is utilized. In this respect I approach the Diesel, which is far removed from automobile engine practice, using a homogeneous charge with high initial pressures and bearings to absorb same and at a time when the crankpin is not in a position to get the full benefit. How near this conforms to theory may also be of interest, in a modern rifle or naval gun where they use slow burning cordite in blocks too big for instantaneous combustion and yet fire an energy that if fired along automobile engine lines would simply burst the gun before the projectile got started.

The History of the Pneumatic Tire—5

An Attempt at Wheel Elasticity in 1875—A D-Shaped Solid Rubber Tire — Pioneer Carriage and Bicycle Types — The Carmont Solid Clincher Tire Patent

The History of the American Automobile Industry—32

By David Beecroft

PROGRESS in tires was not rapid for some years, doubtless because the panic of 1873 made the purchasers feel poor; but in 1874 A. Wietlisbach of Newark, N. J., brought out a rubber tubing tire held to the rim by wire passing through the hole. A similar device using a right-and-left threaded turnbuckle on the wire ends was proposed by George Selden, but his patent application was abandoned. A disk wheel composed of two sheets of steel artistically perforated for lightness and bolted together at the felloe gripping a tire of rubber of circular or rectangular section, as preferred, was patented by L. W. Coe in 1872.

The circular section came into use on bicycles about this time or shortly after in England, and was quickly transferred to America, where it remained in use until displaced by the pneumatic tire about 1890.

In January, 1875, an attempt at wheel elasticity was made by the Rubber Cushioned Axle Co., which brought out its wheel in which the bearing box was set in a cushion of rubber inside the hub, and continued this on the market as late as 1880. Many similar attempts have been since made, but the results are not satisfactory because of the leverage to which the hub is exposed and the increased service that the small amount of rubber at this point is obliged to give.

A D-Shaped Solid Tire

In 1883 a D-shaped solid rubber tire was shown in an American publication as a British product, with the edges of the rim turned inward slightly to grip the widened base of the tire. It closely resembled the Cheever tire of 1869, but was of greater depth. In March, 1884, Peter Gendron of Toledo, Ohio, patented his baby-carriage tire, which consisted of a soft tread and hard base of rubber set into the rim and held there by having the edges rolled inward.

A cycle-wheeled buggy with rubber tires was shown at a British bicycle show in February, 1886, thus indicating that the rubber tire was beginning to find commercial use.

An Early Bicycle Type

About 1883 or 1884 the Star bicycle, built in Smithville, N. J., with sandy roads all around its factory, was fitted with a rubber tire of considerable width, but to save weight and cost the rubber depth was not very great and the center was slightly higher than the sides. This tire, like other bicycle tires of that date, was cemented into the rim and not wired or clinched.

About this time, 1884, Charles E. Duryea applied for a patent on a velocipede and included in this application what seems to be the first of the afterward well-known clincher tire. This device was not permitted to be covered by the claims on the vehicle itself, and so was stricken out of the case and no new application filed for lack of funds. The patent was issued on Feb. 15, 1887, and shows a rubber tire of greater diameter than the rim width, hollow and open on the base. The rim was made with inturned edges which entered grooves formed between the tire beads and the body portion, and thus held the tire in place. The open base permitted accurate molding, so that any desired thickness could be given the tire with the assurance that it would be equally thick all around.

A Tubular Cushion with Wire

Soon after, a patent to E. C. Otto shows a tubular cushion tire secured by a wire passed through the central hole. This tube was made rather long so as to put the rubber under compression, and the wire was corrugated so as to insure a constant pressure of the tire against the rim. This form of tire has never been real successful, because the holding wire was so far above the rim that it worked or moved under the action of the tire and eventually chafed and cut its way through. It has seemed necessary that the holding wires should be below the top of the rim so that they might be undisturbed and therefore not destroy the rubber.

A Modification with Steel Jacket

A modification was a wired method patented in this same year, in which the round rubber cord or tire was held in place by a sheet steel jacket, which jacket had ears that extended radially alongside the felloe, and were provided with slots and pins, by which they were held to the felloe, but permitted movement as the rubber under the jacket compressed. This construction was very impractical and did not appear on the market.

The Rostrum

Why Wire Wheel Hubs Are Offset

EDITOR THE AUTOMOBILE:—Kindly give me full explanation of the principle involved in the manufacture of the wire wheel that necessitates the offsetting of the hub on the outside of the hub as now practiced by the wheel manufacturers. Is this done for looks only or is there a principle of angle levers that makes the construction more solid?

Atlanta, Ga. P. F. L'E.

—The reason for offsetting the hub of the wire wheel is to permit the use of the standard tread in conjunction with a wide base for the spokes. If you imagine a section through the wheel each pair of spokes form a triangle with the width of the hub as the base and the rigidity of the wheel is increased by increasing the width of the hub. If the spokes made equal angles with the hub on the same width of base so that the tire came central with respect to the hub the tread of the car would be increased by fitting such wheels in place of the ordinary wheels.

Another reason for using wire wheels of the offset type is to bring the plane of the tire closer to the plane of the steering knuckle so that even if special axles were designed for wire wheel cars there would still be an advantage in the use of offset construction.

Cause of Popping in Carbureter

Editor THE AUTOMOBILE:—What causes the popping in a carbureter when the mixture is too thin? Is it because of overlap in the exhaust and inlet valve, so that there is a free passage from the carbureter to the burning gases in the exhaust manifold? Would it stop popping to turn back the camshaft one or two teeth so that the valves no longer overlap?

North Cohasset, Mass. H. W. H.

—Popping in the carbureter if the mixture is too thin is not caused by overlap. The speed with which a mixture of gasoline and air burns when ignited depends upon the richness. A weak mixture can be ignited by an electric spark but will burn very slowly, thus at the end of the firing stroke the mixture if very lean will still be alight. It can remain lit throughout the exhaust stroke so that when the inlet valve opens for the next suction there is still burning gas inside the cylinder. This flame immediately flashes back through the manifold into the carbureter.

Information on 1913 Buick 30

Editor THE AUTOMOBILE:—What is the weight of the 1913 Buick model 30?

2—What is the wheelbase of this model and miles per gallon of gasoline claimed?

3—The gasoline tank is 15 in. deep, 38 in. long and 46 in. in circumference. Can you tell me how to find out how much gas there is in there with a rule? For example, when the rule measures 6 in. there is 5 gal.; 11 in., 10 gal., etc.

Haverhill, Mass. J. B.

—The shipping weight of the model 30 was 2750 lb., this weight, of course, being exclusive of water, gasoline, spare tire and passenger load.

2—The wheelbase of this car is 108 in.

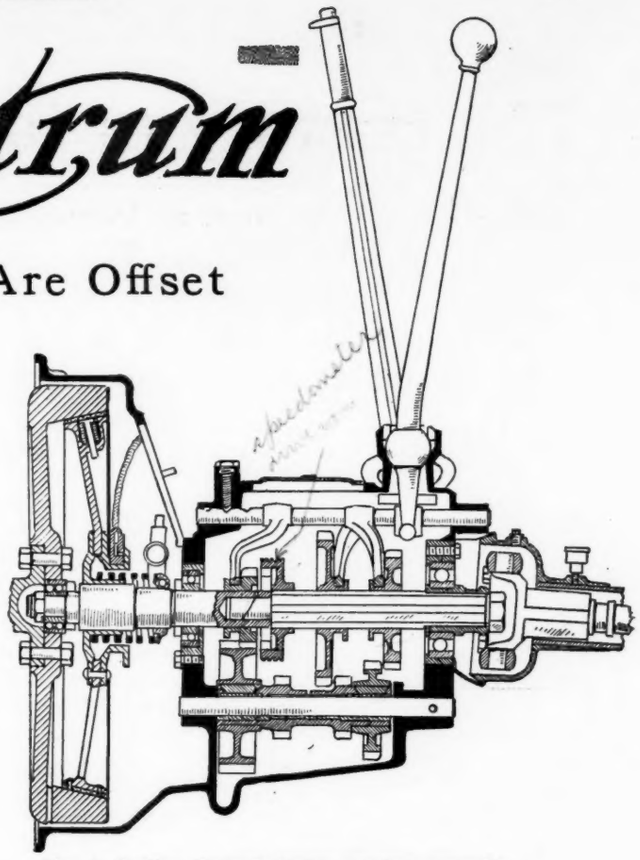


Fig. 1—Section through Dodge gearbox assembly

3—The easiest way to make a gage for the round gasoline tanks used on these cars is to take a stick 24 in. long, and mark off the first 15 in. into ten equal spaces, 1½ in. apart, beginning with the end of the stick. These marks, when numbered from the end of the stick upward, will then indicate the following amounts of gasoline in the tank:

Div.	Gals.	Div.	Gals.
1	1.3	6	15.6
2	3.5	7	18.7
3	6.3	8	21.5
4	9.3	9	23.7
5	12.5	10	25.0

Ammeter Not Advisable on Dodge

Editor THE AUTOMOBILE:—Kindly publish the power curve of the engine used in the Dodge car.

2—What is this car geared on first, second, third and reverse?

3—Publish diagram of electric starting and lighting.

4—Publish diagram of ignition.

5—Show drawing of transmission.

6—How could an ammeter be applied to this car?

Newark, N. J. E. C. McC.

—The power curve of the Dodge car is not available. The peak of the curve is given by the manufacturers at 2000 r.p.m. at which point the engine develops 35 hp.

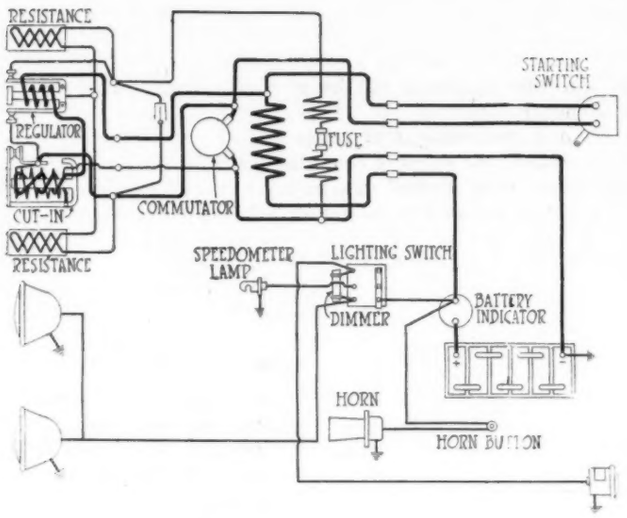
2—The standard gear ratio on high is 3.615 to 1, the driving pinion having thirteen teeth and the driven gear forty-seven teeth. On intermediate the gear ratio is 6.93 to 1 and on low and reverse 16.87 to 1.

3—A wiring diagram and a diagram of circuits are given in Figs. 3 and 2, respectively.

4—Answered under question 3.

5—The transmission is illustrated in Fig. 1.

6—The Dodge company states that it does not advise the



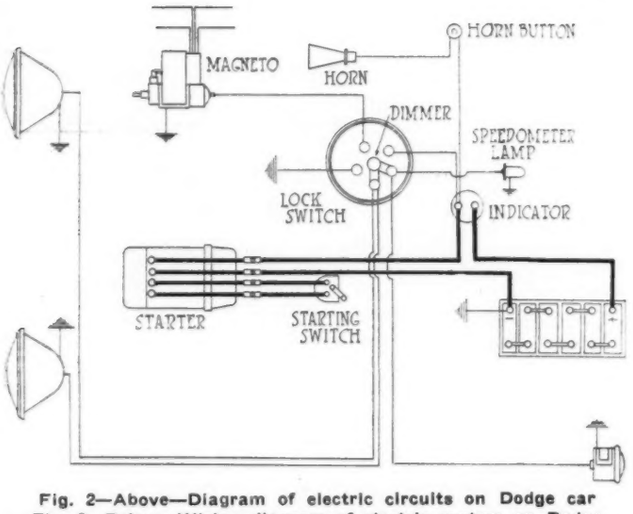


Fig. 2—Above—Diagram of electric circuits on Dodge car
Fig. 3—Below—Wiring diagram of electric system on Dodge

installation of an ammeter on the car as in starting the starter uses about 200 amp. An ammeter installed in the main line would necessitate the use of a shunt winding to prevent it from being burned out the first time the starter was used.

Fitting Magneto to Rambler 45

Editor THE AUTOMOBILE:—Could a high-tension magneto be put on a Rambler model 45 so as to do away with the timer driven by the cam gears and the vibrating coils? If so, what make would be advisable?

2—Would a new carbureter and vacuum system be of any advantage on this car?

3—What power will it develop at 1000 r.p.m.?

4—What speed will the car attain when in good working order? It has 37 by 5-in. wheels.

5—If rebuilt into a truck what would be its maximum capacity?

Thomasboro, Ill. F. BROS.

—A high-tension magneto could be satisfactorily used on a model 45 and we see no reason why any standard make could not be used satisfactorily.

2—We do not believe that a new carbureter would result in a great deal of improvement in the running of the car, but, on the other hand, would suggest repairing the old one as the carbureter with which the car is equipped at present is no doubt the one which was originally placed on the car when it left the factory. Therefore, it has been tested out with this particular motor. The vacuum system is, of course, an advantage in the securing of an even-running motor. The expense of placing it on a model 45 would be considerable, however, as the tank would have to be designed differently and located in a different place, it now being under the seat.

3—This engine develops 45 hp. and 32 hp. at approximately 1000 r.p.m.

4—When the motor is working satisfactorily the car should show a speed of approximately 45 m.p.h.

5—The maximum load that it would be safe to carry would be 1500 lb.

Changing Mitchell S to Fast Roadster

Editor THE AUTOMOBILE:—I have a Mitchell six, model S, that is equipped with a toy tonneau body. What is the gear ratio of each speed of this car?

2—Brake horsepower of the motor?

3—What is the maximum speed of the motor and at what speed does it develop the most power?

4—What is the valve timing?

5—Approximate car speed when new?

6—Is the regrinding of the cylinders and the fitting of new aluminum pistons in a motor of this type and age advisable?

7—I want to fit a speedster body to this car. What suggestions would you make in order to get more speed out of it?

8—Would increasing the compression, timing valves differently, or changing the gear ratio be advisable?

New York City. P. C. D.

—The gear ratios are as follows:

Third speed—direct.
Second speed—1.547 to 1.
Third speed—2.750 to 1.
Reverse—3.850 to 1.

2—The brake horsepower is 43.

3—The greatest power is developed at 1200 r.p.m.

4—Inlet opens 15 deg. past top center, closes 20 deg. past bottom center. Exhaust opens 35 deg. before bottom center and closes 10 deg. after top center.

5—The approximate car speed when new is 55 m.p.h.

6—Yes.

7—Should you decide to fit new pistons, raise the compression to 75 or 80 lb., change axle ratio to 2½ or 3 to 1, close intake 35 deg. instead of 20, open exhaust at 45 deg. instead of 35.

8—Yes.

Adjusting Oldsmobile 27 Carbureter

Editor THE AUTOMOBILE:—Please publish instructions for adjusting the carbureter furnished as standard equipment on the Oldsmobile Autocrat model 27.

Waynesboro, Pa. J. E. O.

—The carbureter is of the Oldsmobile type, especially designed to meet the requirements of the motor. There are only two adjustments to be made under any circumstances—on the needle valve, affecting the flow of gasoline, and on the auxiliary air valve, controlling the admission of the auxiliary air supply. The constricted passage up the center is known as the venturi tube and supplies sufficient air to mix with the proper quantity of gasoline when starting the motor, and for low speeds. At increased speeds the auxiliary valve operates to supply more air to mix with the increased flow of gasoline which is turned on as the throttle is opened.

To describe these features in detail, attention is called first to the throttle and needle valve mechanism. The throttle lever on the steering column, and the accelerator on the foot board operate a butterfly valve known as the throttle. The throttle valve shaft extends clear through the neck of the carbureter and ends in a fixed cam which works directly on the needle valve, opening and closing it as the throttle

opens and closes. Just below the fixed cam is an adjusting nut for the control of the opening or closing of the hole in the needle valve. Turn to the right to decrease, and to the left to increase the flow of gasoline. The throttle is prevented from closing completely by an adjusting thumb-screw on the throttle lever at the carbureter. By adjusting the screw the motor may be throttled down as low as desirable.

The auxiliary air supply, as stated, is furnished by the auxiliary air valve. The valve proper and the spring which regulates it are connected by a lever provided by an ingenious contrivance which may be described as a graduating fulcrum. By this method the single coil spring is used at varying degrees of tension automatically and according to the varying requirements of the motor. At moderate speeds the spring is sensitive and permits the valve to supply additional air at the slightest impulse, while at increased speeds the spring tension is correspondingly increased to compensate for the greater suction of the motor at higher speeds.

A drain cock is provided at the bottom of the carbureter to permit occasional cleaning of the float chamber; in doing this, it is necessary to shut off the main supply valve in the gasoline line. Afterward, flood a little gasoline through, to insure a good flushing, by opening the supply valve.

The Oldsmobile carbureter is waterjacketed so that it may be piped with warm water from the cooling system, to provide a higher temperature in the interior of the carbureter as an aid to the vaporization of the gasoline and the maximum expansion of the gas so formed.

On the lower end of the auxiliary valve stem is a lever which locks the valve shut. This is called the air cut-off and is for ease in starting the motor, i.e., through shutting off all the air except that which is supplied through the venturi tube, a rich mixture is assured.

Tire Cost Chart Issued by Goodyear

Editor THE AUTOMOBILE:—Some time ago one of the tire companies published a chart by which it is possible to figure the cost per mile, knowing the amount paid for the tire and the distance it has run. Would you kindly illustrate this chart?

Brooklyn, N. Y. L. M. H.

—The chart you describe was published by the Goodyear Tire & Rubber Co. It is illustrated in Fig. 4. Placing a straight edge across the chart with one side at the tire mileage and the other at the initial tire cost, the reading on the center column B will give the cost per mile.

Resetting Ford Magnets Usually Recharging

Editor THE AUTOMOBILE:—Is there such a thing as setting the magnets up on a Ford?

2—If so, what does this work consist of?

3—Do all Fords have a certain point on the spark sector (when using the magneto for ignition) where it does not give good ignition?

4—If not all, what is the cause and the remedy for such trouble?

5—As spark plugs will often spark when unscrewed from the cylinders, isn't there some known amount of resistance that could be placed between the points of the plug to equal the pressure of a common motor such as, for example, a piece of notepaper?

6—How can it be told that the magnets in any ignition system are in good condition?

7—Will they show up well at low speed and not at high?

Olmstead, N. D. E. F. F.

—Setting the magnetos up on a Ford generally refers to recharging the magnets.

2—This work consists in recharging by means of special coils.

3—The Ford magneto should give good ignition throughout the entire range of advance.

4—The probabilities are that if firing is weak at one point on the center that the trouble is not in the ignition but in carburetion. If the spark is good at one point there is no reason why it should not be good at a more advanced or retarded point.

5—A known amount of resistance may be placed between the points of the plugs to equal the pressure in a motor. This has never been worked out, however, in terms of thickness of paper so far as THE AUTOMOBILE has any record.

6—When the magnets of a magneto are in good condition good sparks will be given at low speeds.

7—If they give good sparks at low speed they certainly should give at least as good at high.

Knock Probably Due to Carbon

Editor THE AUTOMOBILE:—Will you kindly explain what a spark knock is, how it is caused, and how to remedy it? I have a 1916 Overland which has been run less than 5000 miles and has developed quite a decided knock when accelerating or on hard pulls. The local garagemen say it is a spark knock but cannot be remedied.

Detroit, Mich. G. H. S.

—If the charge is exploded before the piston has quite reached the top of the compression stroke it may produce a knock. Thus if you advance the spark when the engine is running slowly the advanced spark can cause the explosion to take place too quickly.

In the case you mention the knock is almost certainly due to carbon in the cylinders or on the piston heads. A spark knock can always be cured by retarding the spark but if the knock has developed only recently it is absolute proof that it is due to carbon.

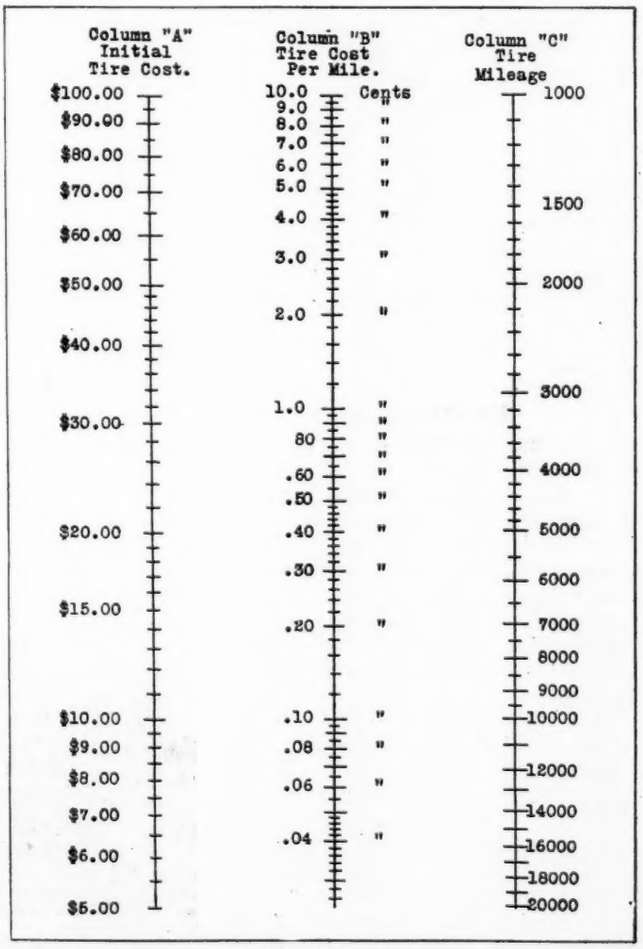


Fig. 4—Tire cost chart published by Goodyear Tire & Rubber Co.

ACCESSORIES

Warner Prairie Schooner

THE equipment of this camping trailer comprises a folding tent of heavy waterproof khaki duck, two folding Pullman beds, 4 by 6 ft., with non-sag springs, including two mattresses, compartment curtains for each bed, an ice chest, a folding table and a folding camp stove. There is also room in the box of the trailer for steamer trunks, blanket rolls, camping supplies, etc., when the tent and beds are folded. The trailer with equipment weighs about 750 lb. and is built to carry 1500 lb. Fitted with pneumatic tires, its speed capacity is 50 m.p.h. and with solid tires 15 m.p.h.

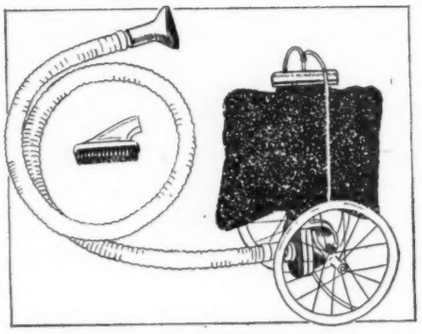
The trailer is built on automobile lines and is highly finished to harmonize with the car and the trailer tongue is adjustable so that the box of the trailer is always level, irrespective of the make of car to which it is attached. The tent used when opened is 7½ by 14 ft., the eight legs supporting the beds and the tent being adjustable so that the beds can be made level on uneven ground. The beds are 4 ft. above the ground, the trailer body forming the floor of the tent. Stakes and guy ropes are included. The entire outfit can be opened and arranged in 10 min. by one man. In 20 min. the equipment can be removed from the Prairie Schooner which can then be used as a commercial trailer. With 30 by 3-in. pneumatic tires the Prairie Schooner sells for $200 f.o.b. Beloit, Wis. With solid tires it is $175 f.o.b. Beloit.—Warner Mfg. Co., Beloit, Wis.

Sterling Utility Cleaner

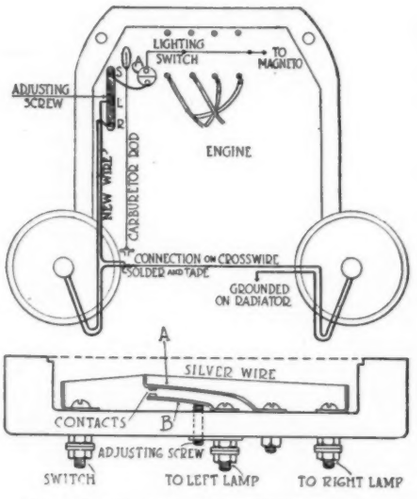
The Sterling is a small portable vacuum cleaner mounted on light rubber tired wire wheels and fills the need for such a cleaner for car upholstery and for other purposes around the sales-room or garage, besides being a suction machine it can be converted into a blower in 30 sec. by removing the bag and inserting the hose in its place. The complete outfit weighs 15 lb. and includes a cast aluminum fan 20 ft. of flexible cord, 8 ft. of 1½ in. hose for suction and blowing, specially designed toothed nozzle, brush for cushions, etc. Price $29.50.—Sterling Sales Co., Chicago, Ill.

Van Sicklen Headlight Concentrator

This device for Ford cars is designed to furnish a bright headlight when the car is traveling slowly, and this is done by cutting out one bulb and sending the full voltage to the other when the speed



Sterling utility vacuum cleaner



Van Sicklen headlight concentrator for Ford cars

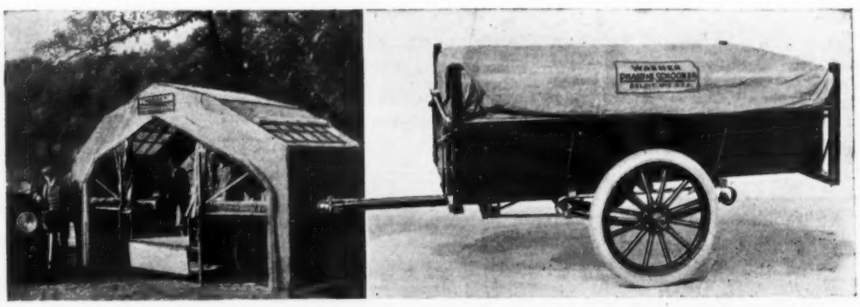
drops below 15 m.p.h. It is merely an automatic switch of small size, which is mounted on the front of the dash. When the voltage of the magneto drops to 9 volts, the device short-circuits one lamp, the full voltage passing through the other. This voltage is sufficient to give full brilliancy. Above 15 m.p.h. current passes through both lamps and the voltage is sufficient to give a good light in both. A fine silver wire is strung between two terminals of the device, one running to the switch and the other to the right lamp. This wire holds down the flat spring *A* which is in contact with the shorter spring *B* as long as the silver wire is cool and unexpanded. This holds for speeds below 15 m.p.h., when all the current which passes through the switch terminal flows through the springs mentioned into the left headlight. Above this speed, the current passing through the wire is sufficient to heat it until it slackens enough to allow spring *A* to move away from *B*, thus breaking the circuit, so that the right lamp is no longer shorted, and the voltage of the magneto now passes through both headlights in series.—Van Sicklen Co., Elgin, Ill.

H_2O Vaporizer

This vaporizer, which was described and illustrated on page 864 of THE AUTOMOBILE for May 11, under the name of the Weco vaporizer, is designed to supply a small quantity of steam to the motor with the fuel mixture, a 2½-qt. copper tank being located on the exhaust pipe where the heat from the exhaust heats the water. A small tube leads the steam to the intake manifold above the carbureter. Better vaporization, lower fuel consumption and absence of carbon deposits are claimed to result from the use of the device. The Weco Mfg. Co., Boston, Mass., was formerly the New England distributor for this device, which is manufactured and sold by the H_2O Mfg. Co., Cambridge, Mass.

Graham Exhaust Ventilator

Small ventilating hoods, installed at the top of the motor hood, have air passages so arranged that the air currents produce a strong vacuum which exhausts the hot air from the engine space. The makers state that the device is capable of exhausting 25,000 cu. ft. of air per hour when the car is moving at an ordinary speed, but that it also operates when the car is standing. The raising of the hood is not interfered with, there are no parts which can get out of order and rain cannot get through. A special type is made for trucks with motors under floors.—Ross-Wortham Co., Chicago, Ill.



Warner Prairie Schooner, with tent opened and as a trailer

The Automobile

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Cutting the Pace

ALTHOUGH visitors to Indianapolis last Tuesday saw a fine race, as was assured beforehand by the many fast cars entered, it will have been something of a disappointment to some that the speed fell short of what was done last year. Reflection, however, shows that it is really a cause for congratulation that so manifestly excellent a race can be run without breaking any speed records. Racing is interesting because it is a contest; it is also exciting largely for the same reason; the excitement natural to the occasion of a contest is merely enhanced by very high speed and not dependent upon it.

The automobile racing of the old type was to open out everything fully and hope that the car would hold together. To-day we are getting such immense power that this practice cannot be followed, the car must be held in check to some extent lest it pound itself to pieces, so the best speed at which to win a race is that speed which will just, and only just, suffice to win.

Another strong impression gained by seeing the 1916 Indianapolis speedway race, after having witnessed several events on the board tracks, is that the old course is of a far more sporting character. There the skill of the driver in taking the turns is ever being called upon to manifest itself in some new way, for with a big bunch running it is often impossible to take a turn in just the same way on each circuit. That the board speedways are faster is not likely to upset the popularity of Indianapolis as long as we have the drivers to put up such a splendid spectacle as that provided on Decoration Day, 1916.

Industrial Warriors

NOT a man who heard Howard E. Coffin's speech on Monday night could have failed to be convinced of the absolute common sense of the program which the industrial preparedness committee has before it. All in the automobile industry should respond to the appeal as one man, for they all know and appreciate the ability and the creative power of the man at the head of affairs. As long as Howard Coffin holds the wheel and has his foot on the accelerator, the work will go ahead quickly and certainly.

Truck Transmission

IN the evolution of all kinds of machinery the time always arrives when compromise has to be struck, and the automobile is by far the greatest example of compromise which it would be possible to find.

For example, we all know that it is a vicious thing, mechanically speaking, to take power around a corner. We all know that it is possible to build a chassis so that the crankshaft is parallel with the axles, and we also know that such cars are not built because the drawbacks of the construction more than outweigh the theoretical advantages.

For this reason it is never either safe or right to base an argument about any detail of automobile construction solely upon theoretical grounds. Theory must take its place, should be the basis of nearly all good mechanical controversy, but it must be backed up or compared with a proper balancing of the *practical*.

A machine is made for the purpose of performing certain work. A motor truck is made to carry goods. If all motor trucks had to carry the same goods in the same loads over the same roads, it might be easy to find a single ideal design, but so long as everything from the selling price to the nationality of the driver affects the conditions of service, so must the design be a matter of compromise.

Now, when a dozen different men start work independently upon the same problem and that problem is hedged with practical difficulties, they are certain to work out a dozen different solutions. They may all be correct solutions, but more likely they will all be incorrect, some approaching nearer to the right answer than others.

There are scores of different ways of getting power from the engine to the road wheels of a truck, and we are using about six of them to-day. In 3 years we may be using six more as electric and hydraulic schemes are brought to perfection. Thus it is much more probable that more study will produce more types of drive than that it will reduce them, and it is beyond belief that there will be one final system within the present century at any rate.

Macauley to Succeed H. B. Joy

To Be Packard President—Joy Remains Chairman of Directors' Board

DETROIT, MICH., May 31—Alvan Macauley, vice-president and general manager of the Packard Motor Car Co., is soon to be given the title of president in recognition of his service in the affairs of the company. H. B. Joy, now president, will remain actively connected with the organization as chairman of the board of directors.

Mr. Macauley has virtually been president of the Packard company for the past 2 years and the upbuilding of that organization is in his hands and the responsibility also is his. Mr. Joy has been working toward the end of broadening and strengthening the organization to meet the conditions of its very much enlarged business conditions, thus requiring more help at the top. As a result the title of president of the company will be conferred on Mr. Macauley in the near future at the request of Mr. Joy and with the approval of the directors as a well merited recognition of Mr. Macauley's ability.

The change in titles of the officials of the company will not change the conditions which have been in effect for much more than a year.

—

Hayes to Make Wire Wheels

JACKSON, MICH., May 29—To meet the demand for wire wheels as well as the wood type, the Hayes Wheel Co. has decided to manufacture the wire type along with its wood wheel production. General selling agent for the Hayes wire wheel will be the Castle & Kyte Co., 872 Woodward Avenue, Detroit. The latter is a new organization, composed of F. E. Castle, well known in the trade as the head of the F. E. Castle Co., and H. W. Kyte, former assistant general manager of the Houk Mfg. Co., Buffalo.

—

Packard Plans Stock Increase

DETROIT, MICH., May 29—P. H. McMillan, secretary and treasurer of the Packard Motor Car Co., has called a special meeting of the stockholders for June 3, at which time action will be taken on a proposal to increase the capital stock of the company from $8,000,000 common stock to $13,000,000 authorized. At the present time there is outstanding $7,065,300 in common stock, $934,700 of that at present authorized being unissued. The $8,000,000 authorized preferred stock will be changed. There is outstanding $5,000,000 of this, the remaining $3,000,000 being retained in the treasury.

It is not stated at this time just what disposition will be made of the new funds resulting from this stock issue, if approved, but with the earnings running very high, it is probable that it will be devoted to plant extensions and a still further strengthening of the Packard's financial position. At the present time Packard is earning approximately 60 per cent on the present common stock for the current fiscal year, after charging off $1,700,000 for depreciation.

—

1917 Moon Little Changed

ST. LOUIS, MO., May 27—For the first time in the history of the Moon Motor Car Co., this city, there will be no radical changes in Moon cars for the 1917 season.

Because of the congested condition of the material market, the rush to keep ahead of the demand, it is necessary to place orders for parts 6 to 8 months in advance.

This condition prompts the company to hold to the lines of its 1916 models to a large extent for 1917. In order to be ready to put out radically different models in July, it would be necessary this year for the manufacturer to place his orders for parts in December or January, too early to determine definitely what changes were desirable.

It means, too, that the Moon factory will run 100 per cent capacity during June and July. In other words, there will be no lapse in the manufacturing end at all between the end of the 1916 season and the opening of the 1917 season.

—

Mid-West S. A. E. Meets June 2

CHICAGO, ILL., May 31—"Art and the Motor Car," by W. B. Stout of the Scripps-Booth Co., is one of the papers to be read at the June 2 meeting of the Mid-West Section of the Society of Automobile Engineers. Another paper will be "Problems Involved in the Choice of Motor Truck," by Henry Farrington of the Thomas B. Jeffery Co.

—

Carter Heads Philadelphia Engineers

PHILADELPHIA, PA., May 27—At the annual meeting of the Engineers' Club of Philadelphia, with which is affiliated the Pennsylvania section of the S. A. E., the following officers were elected: President, E. B. Carter; vice-president, J. H. M. Andrews; secretary, Robert H. Fernald; treasurer, William M. Irish.

—

Argo Receives French Order

JACKSON, MICH., May 29—The Argo Motor Co., this city, has received an order of 250 cars from the Exporters of Manufacturers' Products of France.

Aluminum Motor for Premier

New Model to Have Electric Gearshift — Thermostatic Water Cooling Control

INDIANAPOLIS, IND., May 25.—Details on the new Premier, which will be put on the market within the next few months by the Premier Motor Corp., are just beginning to be known to the industry. The present organization which has taken over the huge plant of the T. B. Laycock Co., manufacturer of bed springs, is ready to begin operations as soon as the machinery which has been ordered is installed and started on production.

Modern ideas are incorporated throughout the chassis which has an aluminum motor with cast iron cylinder sleeves. The entire cylinder and crankcase is a unit casting of Lynite and the motor dimensions are 3⅜ by 5½. According to present plans the motor will have overhead valves carried in a separate valve head casting. Aluminum pistons, counterbalanced crankshaft and helical camshaft drive are other features.

Among the other important specifications of the car are thermostatic water cooling control, unit power plant, single plate clutch, Cutler-Hammer electric gearshift, Timken spiral bevel axle, sheet steel body and a deep frame, scientific chassis design. Collins curtains that open with the door will be used. The price will be, according to present plans, $1,685 for a seven-passenger touring model.

This concern is now occupying an ideal plant covering a tract of 40 acres and having a floorspace of about 327,000 sq. ft. It is capitalized at $2,500,000.

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Denby Truck Prices and Load Capacities Revised

DETROIT, MICH., May 29—The Denby Motor Truck Co. has revised the prices of its several models as follows: Type R, 1-ton capacity, $1,020; type G, 1½-ton capacity, $1,575; type H, 2-ton capacity, $1,790, and type K, 2½-ton capacity, $2,090. It is explained that while these new prices seem higher, they are in reality little changed over the old figures, inasmuch as the Denby trucks have been underrated heretofore and, while they were amply able to carry larger loads, it is only now that they have been given a revised and greater load rating. The new prices, therefore, are simply commensurate with the added capacity. Of course, in making these changes in load ratings, certain alterations have been made in the chassis to take care of all contingencies with the heavier loads, making the vehicles in every sense capable of the work they do.

Ward Leonard Co. in New Plant

Occupies Factory with 50% Larger Manufacturing Facilities in Mt. Vernon

MOUNT VERNON, N. Y., May 26.—The Ward Leonard Electric Co. has moved into its new building in this city. The need of more space and labor operators was the reason for the company moving from Bronxville. The floor space has been increased approximately 50 per cent.

The Ward Leonard Electric Co. started manufacturing electric controlling devices in Bridgeport, Conn., in 1892. After 2 years in Bridgeport, and 3 years in Hoboken, N. J., it moved to Bronxville, N. Y., and has been manufacturing in Bronxville since 1897, or for the past 19 years. The new location is nearer New York.

A 6-Weeks Engineering Course

DENVER, COL., May 26—A short course in automobile and tractor engineering will be given this summer by the Colorado Agricultural College, at Fort Collins. The special course will start June 19 and continue 6 weeks. It will be a practical course for garagemen, car owners, farmers, chauffeurs, threshermen, farming contractors and car and tractor salesmen.

S. C. Johnson & Son Raise Wages 10 Per Cent., Due to Prosperity

RACINE, WIS., May 27.—S. C. Johnson & Son, manufacturing Johnson's prepared wax and cleanser, gave their entire force of employees an agreeable surprise on the last pay-day by adding 10 per cent to their checks and announcing that all wages will be 10 per cent higher in the future. The company employs about 200 men and the wage increase means an additional outlay of $15,000 annually. The action was taken to carry out the wishes of S. C. Johnson and Herbert F. Johnson, owners of the concern that the employees share in the prosperous condition of the business.

Martin V. Kelley Co. Opens Branch in New York

NEW YORK CITY, May 31.—The local branch of the Martin V. Kelley Co., Toledo, Ohio, will be opened to-morrow. The New York City office of this advertising concern will be at 171 Madison Avenue. The company's invasion of this city is due to the purchase by Mr. Kelley of the entire business of Bromfield & Field, Inc., New York.

The new accounts taken over by the Kelley company include the Fisk Rubber Co., Chicopee Falls, Mass.; Ajax Rubber Co., Trenton, N. J.; Mercer Automobile Co., Trenton; F. I. A. T., Poughkeepsie, and the Boston Woven Hose & Rubber Co. The Toledo office includes among its accounts fourteen companies in the automobile field. In taking over the local concern R. A. Field, treasurer of the firm, has been retained and also becomes a vice-president.

Goodman Sets Up For Himself

NEW YORK CITY, May 29—Henry Goodman, who has managed the New York office of the Springfield Metal Body Co. for 2 years, has incorporated the Goodman Auto Body Co. and will handle the Springfield business in eastern territory, the change taking effect June 1. He will continue the office at 1737 Broadway.

Mr. Goodman, who is president of the new company, was connected with the Pope Mfg. Co. for 18 years.

Allen's 300 per Cent Dealer Gain

FOSTORIA, OHIO, May 27.—The Allen Motor Co., this city, reports an increase of 300 per cent in the number of its dealers during the past year. The company's production of cars has tripled in the past 11 months and the dealers' orders exceed the factory's capacity by 50 per cent.

Premier Appoints District Managers

INDIANAPOLIS, IND., May 24.—The Premier Motor Corp., this city, has appointed the following district managers: In the East, H. C. Arnold, formerly with the Hudson Company in Chicago; West, H. L. Pelton, formerly with the Chalmers company; Southwest, A. G. Dale, formerly selling Chandler cars; Northwest, R. S. Ellis, formerly with the Winton company in Detroit; Pacific Coast, P. A. Berry, formerly distributor of the Packard and Hudson in Tacoma, Wash.

Duluth Jitney Ordinance Upheld

DULUTH, MINN., May 27.—The Supreme Court of the state has upheld the jitney ordinance of this city. Police are notifying jitney operators to take out licenses at once. They must pay a wheelage tax also. The law provides strict regulations and the filing of accident bonds. The ordinance was passed in May, 1915. Before effective a referendum petition was filed against it. It was agreed with jitney operators certain provisions would be withdrawn. The ordinance was repealed. Some jitney men refused to abide by the agreement as to the second ordinance. One driver offered himself as test. The court held that the second ordinance differed in important particulars from the first and that the evidence did not show the council acted in bad faith.

DeLaski Loses Tire Core Suit

Decision in Favor of U. S. Tire Co. Upheld by Circuit Court of Appeals

NEW YORK CITY, May 27.—The decision by Judge Hand in the United States District Court in favor of the United States Tire Co., last December, in a suit brought against it by the De Laski & Thropp Circular Woven Tire Co., has been upheld by the United States Circuit Court of Appeals in New York. The case was an effort on the part of the De Laski & Thropp company to secure the upholding of its tire core patent by means of new testimony, following a decision of the Circuit Court of Appeals, holding the patent invalid because anticipated.

The patent in question covered molds used in the manufacture of tires by practically the entire industry, and if upheld would have given a practical monopoly to the owner.

The lower court held the patent invalid through having been anticipated by the B. F. Goodrich Co.

Maryland Jitneys Under P. S. C.

BALTIMORE, MD., May 29.—Beginning July 1 all jitney buses operated in Maryland must have permission from the Public Service Commission. Under the provisions of a law enacted by the General Assembly the Commission must approve the lines before the proprietors will be able to secure licenses from the Automobile Commissioner.

To Test Duluth Wheel Tax

DULUTH, MINN., May 27.—Under the auspices of the Automobile club a move has begun to test the city wheelage tax in the courts. At a meeting of 500 car owners President J. D. Park of the club was authorized to appoint a committee of seven to take the steps. Seventy-five new members were added to take part in the campaign. The tax is held unjust in addition to the personal property tax on automobiles. The law went into effect in July, 1910. The tax is 50 cents per horsepower for cars and $10 per ton for trucks.

Open Motor Demonstration Field

SAN DIEGO, CAL., May 22.—The motor demonstration field at the Panama-California Exposition was opened last Saturday, May 20. The opening celebration was in charge of the San Diego Automobile Dealers' Assn. On Saturday the dealers engaged in a gymkana on the field and the following day a provisional company of the California Section, Automo-

bile Reserve Corps maneuvered on the field with the Twenty-eighth Company, Coast Artillery Corps, United States Army. The cars were driven from Los Angeles by members of the Automobile Reserve Corps and the command returned to Los Angeles as soon as the maneuvers at the exposition were over and the U. S. regulars had been transported back to Fort Rosecrans, where they are stationed. The run was the longest of any yet attempted by a large fleet of cars under the colors of the A. R. C. Of the twenty or more cars in the line, not one suffered from mechanical or tire trouble on the entire trip and the entire command rolled into San Diego just as it left Los Angeles and returned the same way.

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Buick Ambulance Sent to France by Wilmington

WILMINGTON, DEL., May 29—As the result of a campaign which has been carried on in this city for the collection of funds to aid in French army relief, a model field ambulance has just been completed in this city and will be shipped in a few days. The car was built by the Wilmington Automobile Co. It is mounted on a Buick chassis, has heavy-duty tires and all parts of the sub-construction are suitable for the strenuous service it undoubtedly will undergo.

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Canadian Market for English Cars

MONTREAL, QUE., May 29—The English automobile manufacturer is going to invade the Dominion as soon as the war is over, and will establish agencies in all the provincial cities and towns throughout Canada. The English manufacturer will especially feature light cars, and there is a large field in this country for the cars the English manufacturers are turning out. There are a few light cars of English make in this city at present, and several of a French make. The cars are complete in every detail, are moderate in price and the cost of upkeep is very small.

American Brass Co. To Expand

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Plans Expenditure of $1,600,000 to $2,000,000 in Enlarging Its Plant

KENOSHA, WIS., May 27.—The American Brass Co., Waterbury, Conn., operating a large rolling mill and brass foundry at Kenosha, Wis., has made public plans for improvements at Kenosha to cost between $1,600,000 and $2,000,000, which will make the local works the largest of the kind in the country. At the same time about $400,000 will be expended in enlarging the Waterbury works. At Kenosha the brass mill will be enlarged by an addition, 320 by 225 feet, and the foundry by an addition of 320 by 200 feet. A new administration building is included in the plans, which will require about 2 years to carry out.

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Emerson Plans $10,000,000 Plant

PHILADELPHIA, PA., May 30—The Emerson Motor Car Mfg. Co., recently formed to build the S. S. E. car, will build a $10,000,000 plant in this city. The buildings and equipment will cost between $2,000,000 and 3,000,000.

The concern is composed of New York City and Chicago capitalists and has a capital of $10,000,000, which is stated to be all paid in.

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Gasoline Lower in Oklahoma — Unchanged in Eastern States

NEW YORK CITY, May 29.—Gasoline prices in this city continue unchanged. So far, dealers say, none of the large refineries have indicated their intention of advancing the wholesale charge, which continues at 24 cents a gal., in this city and 23 cents in New Jersey.

Retailers in this city are asking from 27 cents to 31 cents a gal. In New Jersey, some of the dealers are selling at 24 cents a gal.

Oklahoma gasoline prices were reduced last week 2 cents a gal. to 23 cents tank wagon basis.

The active season for gasoline is near at hand, and it is predicted that the chances for a downward revision in prices are not promising. In fact, higher prices are looked for when the consumption of gasoline is at its maximum.

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Now Durston Gear Co.

SYRACUSE, N. Y., May 29.—The Durston Gear Co., this city, has been incorporated to carry on the business of the Lefever Arms Co., whose corporate existence has ceased. During the past few years the business of the gear department of the Lefever company has taxed the entire space of its factory, requiring the entire attention of the company. As a result the assets, other than the factory and machinery of the gun department were sold. The proceeds of this sale were transferred to the gear department. The management, ownership and the financial responsibility of the new company remains the same as the old company.

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Electric Taxicabs for Chicago

CHICAGO, ILL., May 29.—Guy Woods, the owner of the American Motor Livery Co. of Chicago, has recently placed an order with the Milburn Wagon Co. for twelve specially built electric town cars to be especially equipped. The new electric cab will be of the limousine type and will accommodate five passengers.

Electric taxicabs have for some time past successfully operated in Detroit. The Detroit Taxicab & Transfer Co. now operates a fleet of fifteen electric cabs.

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Chevrolet Exports to Australia

NEW YORK CITY, May 29—The Chevrolet Motor Co., this city, is exporting 384 cars to-day for ports of Australia and New Zealand, and has a rush order for 900 more. The steamship *Florence Luckenbach*, which will carry the cars, is taking the largest single export shipment of passenger cars ever leaving an American port.

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Olds Doubles Production

LANSING, MICH., May 29—The production of Oldsmobiles, already well beyond the 10,000 mark per annum, is to be raised to 20,000 cars next season.

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Materials Market Steady

NEW YORK CITY, May 29—With the exception of a further drop in copper prices, the materials markets on the whole were steady. Both electrolytic and lake coppers dropped 1¼ cents a lb. to 28 cents. The copper market was dull due to sharp breaks at London, indirectly

Daily Market Reports for the Past Week

Material	Tues.	Wed.	Thur.	Fri.	Sat.	Week's Ch'ge
Aluminum, lb.	.58	.58	.58	.58	.58	...
Antimony, lb.	.28	.27	.26½	.25	.25	— .03
Steel Beams and Channels, 100 lbs.	2.77	2.77	2.77	2.77	2.77	...
Steel Bessemer, ton	45.00	45.00	45.00	45.00	45.00	...
Copper, Elec., lb.	.29¼	.29	.28½	.28	.28	— .01¼
Copper, Lake, lb.	.29¼	.29	.28½	.28	.28	— .01¼
Oil, Cottonseed, bbl.	10.85	10.85	10.80	10.70	10.70	— .15
Oil, Fish, Menhaden, Brown, gal.	.55	.55	.55	.55	.55	...
Oil, Gasoline, Auto, bbl.	.24	.24	.24	.24	.24	...
Oil, Lard, prime, gal.	1.10	1.10	1.10	1.10	1.10	...
Lead, 100 lbs.	7.25	7.25	7.25	7.25	7.25	...
Oil, Linseed	.70	.70	.70	.70	.70	...
Steel, Open-Hearth, ton	42.00	42.00	42.00	42.00	42.00	...
Oil, Petroleum, bbl., Kans., crude	1.55	1.55	1.55	1.55	1.55	...
Oil, Petroleum, bbl., Pa., crude	2.60	2.60	2.60	2.60	2.60	...
Oil, Rapeseed, refined, gal.	1.05	1.05	1.05	1.05	1.05	...
Rubber, Fine Up-River, Para., lb.	.68	.67½	.67½	.67	.67	— .01
Rubber, Ceylon, First Latex	.70	.70	.70	.70	.70	...
Sulphuric Acid, 60 Baume, 100 lb.	3.00	3.00	3.00	3.00	3.00	...
Tin, 100 lb.	48.00	47.50	47.50	47.50	47.50	— .50
Tire Scrap, lb.	.05¾	.05¾	.05¾	.05¾	.05¾	...

affecting the market. There is little forward buying now in evidence.

Para rubber has dropped to 67 cents a lb. with an easy market in both that grade and Ceylon. The last name has been shown very little interest lately and quotations have been maintained steadily at 70. Mail advices from London state in their explanation of the present low rubber prices that considerable quantities in the warehouses there have been sold, the shipment of which to America has been rather seriously delayed through the difficulty in getting permits.

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Goodyear Capital Increased $18,000,000

AKRON, OHIO, May 29.—The Goodyear Tire & Rubber Co., Akron, has filed papers with the Secretary of State increasing its preferred stock from $7,000,000 to $25,000,000. The common stock of the company already amounts to $25,000,000, making a total capital of $50,000,000.

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Dividends Declared

Yale & Towne Mfg. Co., quarterly of 1¾ per cent, payable July 1 to stock of record June 23 and an extra dividend of 10 per cent, payable June 7 to stock of record May 31.

Chandler Motor Car Co.; quarterly of 2 per cent and extra dividend of ½ per cent, payable July 1, 1916, to stock of record.

Packard Motor Car Co.; quarterly of 1¾ per cent on preferred, payable June 15 to stock of record May 31. Books do not close.

Record Prices for Securities

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General Motors Rises 84 Points —Chevrolet Up 11—Activity and Strength

NEW YORK CITY, May 29.—Another period of activity and strength among the automobile and accessory shares has set in. The motor market was featured by United Motors Corp., selling on a when issued basis. Sales in this security alone totalled 150,500 shares. From an opening of 64½ points, the stock advanced to 78 on Saturday. The movement in United Motors was responded to by a 20-point rise in Perlman Rim Corp. stock, which is to be a part of the United Motors Corp.

On Thursday Chevrolet opened at 249, a new high level. General Motors has advanced to 515 or 115 points higher than its low cost this year. Rumors had it that a special cash disbursement of $100 might be made at the end of the current fiscal year. Earnings for the year, it was said, would probably approximate $25,000,000, which after payment of the preferred dividend would leave around 150 per cent on the common. Chandler Motors was another strong feature of the motor group, with a rise of 5½ points. This company is reported to be earning at the rate of 20 per cent a year. It is expected that the present 6 per cent dividend rate will be placed higher at the coming directors' meeting.

Peerless Truck went up 5½ points to 102. Net earnings of this corporation in April were approximately $200,000, or at the rate of $2,400,000 annually. This has been the monthly average since the first of the year.

Saxon stock went up to 83, a gain of 9½ points. This company inaugurated dividends recently by paying $1.50 a share, thus placing the stock on a $6 a year basis. The stock is soon to be placed on the New York Stock Exchange.

Splitdorf magneto fractional stock is being bought and sold by Kidder, Peabody & Co., in order to make full shares, on the basis of $95 a share for the preferred and $75 a share for the common. As the dividend to Torrington common shares amounts to 7-100 of a share of Splitdorf preferred and 1-10 share of common, the total value of the dividend is about $14.15.

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80% Paige-Detroit Stock Dividend Approved by Stockholders

DETROIT, MICH., May 26—Stockholders of the Paige-Detroit Motor Car Co. at a special meeting Wednesday in the company's general offices gave their approval to the recommendation by the company's directors that a stock dividend of 80 per cent of the par value of $400,000 be distributed pro rata to the stockholders of record May 13.

Approval was given also to the directors' recommendations that the authorized capital stock of the company be increased from $1,000,000 to $2,000,000 and that the par value of the stock be cut down from $100 to $10 a share.

Automobile Securities Quotations on the New York and Detroit Exchanges

	1915 Bid	1915 Asked	1916 Bid	1916 Asked	Wk's Ch'ge
Ajax Rubber Co. (new)	..	..	66½	68	+ ½
Aluminum Castings pfd	98	100	..	..	..
J. I. Case pfd	..	..	86	90	..
Chalmers Motor Co. com	89	91	170	180	+10
Chalmers Motor Co. pfd	95	97	97	101	+1
Chevrolet Motor Co	..	..	242	244	+11
Chandler Motor Car Co	..	..	102	103	+5½
Electric Storage Battery Co	..	..	62	64	+2
Firestone Tire & Rubber Co. com	475	480	840	860	+10
Firestone Tire & Rubber Co. pfd	110	112½	113	114	..
General Motors Co. com	135	136¼	515	525	+84
General Motors Co. pfd	98	100	116	117	— ½
B. F. Goodrich Co. com	43	45	75¾	76½	..
B. F. Goodrich Co. pfd	101¼	102	115	115½	..
Goodyear Tire & Rubber Co. com	240	..	392	396	+12
Goodyear Tire & Rubber Co. pfd	105	106	105	106	..
Grant Motor Car Co	..	..	11½	12½	+ ½
Gray & Davis, Inc., pfd	..	..	..	..	..
International Motor Co. com	14	15	10	14	..
International Motor Co. pfd	34	38	22	30	..
Kelly-Springfield Tire Co. com	127	130	72	73	+2
Kelly-Springfield Tire Co. 1st pfd	82½	85	95	99	—1
Kelly-Springfield Tire Co. 2d pfd	115	135	..	..	..
Maxwell Motor Co. com	42½	44	85½	86½	+ ½
Maxwell Motor Co. 1st pfd	86	87½	89	91	+ ½
Maxwell Motor Co. 2d pfd	37	38¾	57	59	— ½
Miller Rubber Co. com	180	185	300	..	..
Miller Rubber Co. pfd	104	105	115	..	..
New Departure Mfg. Co. com	136	141	275	285	—2
New Departure Mfg. Co. pfd	106	..	113	..	..
Packard Motor Car Co. com	..	104½	225	..	+21
Packard Motor Car Co. pfd	..	100½	100	105	..
Paige-Detroit Motor Car (new)	..	..	45	60	..
Peerless Motor & Truck Corp	..	..	25½	26	+5½
Perlman Rim Corp	..	..	148	150	+20
Portage Rubber Co. com	35	38	85	88	..
Portage Rubber Co. pfd	85	88	107½	108½	..
Regal Motor Co. pfd	..	..	20	30	..
*Reo Motor Truck Co	14⅞	15½	38	38¾	+1
*Reo Motor Car Co	32¾	33½	42	42¾	—2½
Saxon Motor Car Co	..	..	83	85	+9½
Splitdorf Electric Co. pfd	..	..	..	..	..
Standard Motor Co	..	..	8	8½	..
Stewart-Warner Speed. Corp. com	64	67	88½	89½	+ ½
Stewart-Warner Speed. Corp. pfd	103	105	109	..	..
Studebaker Corp. com	67	69	137	139	— ½
Studebaker Corp. pfd	97½	99½	107	111	—2
Swinehart Tire & Rubber Co	80	90	83	84	..
Texas Company	123½	125	192	194	+1
United Motor Corp	..	..	78	78½	+14½
U. S. Rubber Co. com	62	64	55¼	56	+ ½
U. S. Rubber Co. pfd	105	107	109	110	..
Vacuum Oil Co	200	205	249	252	+6
White Motor Co. (new)	..	..	50½	50¾	—1
Willys-Overland Co. com	114½	116½	265	275	—6
Willys-Overland Co. pfd	100	103	106	107	..

OFFICIAL QUOTATIONS OF THE DETROIT STOCK EXCHANGE

ACTIVE STOCKS

	Bid	Asked	Bid	Asked	Ch'ge
Auto Body Co	..	..	34½	..	..
Chalmers Motor Co. com	88	91	179	..	+16½
Chalmers Motor Co. pfd	94	97	96	100½	..
Continental Motor Co. com	175	185	37¾	38¾	+ ¼
Continental Motor Co. pfd	84	86	9½	10⅛	..
Ford Motor Co. of Canada	950	1000	..	400	..
General Motors Co. com	135	140	430	525	..
General Motors Co. pfd	98	99	115	119	+1
Maxwell Motor Co. com	41½	43½	84½	87½	— ½
Maxwell Motor Co. 1st pfd	85½	87½	88½	91½	— ½
Maxwell Motor Co. 2d pfd	36½	38½	57½	60	+2½
Packard Motor Car Co. com	102	104	230	240	+24
Packard Motor Car Co. pfd	99	..	101	104	..
†Paige-Detroit Motor Car Co	..	..	55	..	..
*W. K. Prudden Co	19½	21	..	47	..
*Reo Motor Car Co	32¾	33¾	42	43	—2½
*Reo Motor Truck Co	14¾	15⅝	37½	38½	+1½
Studebaker Corp. com	66	68	136½	139½	+1½
Studebaker Corp. pfd	..	99	110	..	+2

INACTIVE STOCKS

*Atlas Drop Forge Co	..	26	..	40	..
Kelsey Wheel Co	200	..	..	350	..
Regal Motor Car Co. pfd	..	25	17	..	+1

*Par value $10. †New stock.

Cars Are Faster Than Their Drivers

Indianapolis Produces Opposite Effect to That on Board Speedways Where Drivers Are Speedier Than Cars—Cooling Engines and Tires—Carburetion and Lubrication

(*Continued from page 966*)

INDIANAPOLIS, IND., May 30—The Indianapolis contest is more of a race of drivers than is Sheepshead Bay or Chicago; the whole situation is summed up in the statement that on the board speedway the drivers are faster than their cars, while at Indianapolis the cars are faster than the drivers. The turns must be coasted and hence speed is lost twice in every lap.

Owing to the necessity for reducing the speed the cars that have the greater acceleration possess a great advantage. This quality of acceleration means that reserve power must be on tap. The engine must be ready to carry the speed back to the highest safe maximum and must be able to hold it there. This condition makes for circumstances that are much more difficult for the engine to meet.

It is this shutting down that causes so many oiling troubles on the Indianapolis track. The closing of the throttle allows the oil to accumulate and it is forced up into the combustion chamber, with the result that the plugs are fouled and have to be frequently renewed. Indianapolis is the hardest speedway on spark plugs in the country, for this reason.

Carburetion Important

Carburetion on the Indianapolis speedway is one of the points which must be watched carefully as the tendency for the driver to step down hard upon the accelerator pedal in coming out of the turns, puts the hardest kind of service up to the carbureter. The tendency is toward a failure to supply sufficient gasoline quickly in order to meet the demands of the wide open throttle. The multi-jet carbureter has been found to work out very well in this respect, because the gasoline has the tendency to collect in the jet wells when the throttle is closed and then to be available immediately upon opening the throttle.

A study of the pit stops does not reveal any definite weakness, unless it be in the tendency to short-circuit the plugs, due to accumulation of oil. It naturally gives rise to the thought that the clearances with the aluminum pistons may be too high. This seemed to be shown particularly in the Frontenac cars, which were in and out of the pits many times, for the purpose of changing plugs. The space before the Frontenac pit was covered with oil and it seemed to show that a great excess was reaching the combustion chamber because the number of plugs that were cleaned and renewed

Details and Equipment of Cars in the Indianapolis 300-Mile Race

No.	Car	Driver	Cyl.	Bore	Stroke	Carb.	Plugs	Pistons	Valves	Oil	Wheels	Tires	Front	Rear	Wheel-base
1	Duesenberg	D'Alene	4	3.9	6	Miller	Rajah	Levett	8	Oilzum	Rudge	Silvertown.	32x4½	33x5	106
4	Maxwell	Henderson	4	3.75	6.75	Miller	Rajah	Levett	16	Oilzum	Houk	Silvertown.	34x4½	35x5	106
5	Maxwell	Rickenbacher	4	3.75	6.75	Miller	K.L.G.	Levett	16	Oilzum	Houk	Silvertown.	34x4½	35x5	106
6	Frontenac	L. Chevrolet	4	3.87	6.375	Zenith	Rajah	Alum.	16	Monogram	Rudge	Silvertown.	33x4½	33x4½	104
7	Frontenac	A. Chevrolet	4	3.87	6.375	Zenith	Rajah	Alum.	16	Monogram	Rudge	Silvertown.	33x4½	33x4½	104
8	Frontenac	G. Chevrolet	4	3.87	6.375	Zenith	Rajah	Alum.	16	Monogram	Rudge	Silvertown.	33x4½	33x4½	104
9	Osteweg	Haibe	4	4.35	5	Miller	Answer	Levett	16	Castor	Houk	Silvertown.	32x4½	33x5	102
10	Peugeot	Mulford	4	3.662	6.625	Zenith	Rajah	Levett	16	Oilzum	Rudge	Silvertown.	34x4½	35x5	110
12	Ogren	Alley	4	3.989	6	Miller	Rajah	Levett	8	Castor	Houk	Nassau	.....	.....	106
14	Sunbeam	Christiaens*	6	3.213	6.25	Miller**	Champion	Steel	24	Mixed	Rudge	Firestone	35x5	35x5	113
15	Delage	Oldfield	4	3.726	6.31	Miller**	Rajah	Levett	16	Oilzum	Rudge	Firestone	34x4½	35x5	104
17	Peugeot	Resta	4	3.655	6.6	Miller	K.L.G.	Levett	16	Oilzum	Rudge	Silvertown.	34x4½	35x5	106
18	Peugeot	Aitken	4	3.655	6.6	Zenith	K.L.G.	Levett	16	Oilzum	Rudge	Silvertown.	34x4½	35x5	100
19	Peugeot	Merz	4	3.655	6.6	Zenith	K.L.G.	Levett	16	Oilzum	Rudge	Silvertown.	34x4½	35x5	106
21	Delage	Devigne	4	3.70	6.31	Miller***	K.L.G.	Levett	16	Castor	Rudge	Silvertown.	33x4½	33x5	106
22	Delage	LeCain	4	3.70	6.31	Miller	.....	Levett	16	Castor	Rudge	Silvertown.	.....	.....	106
23	Peusun	Franchi	4	3.706	6.31	Miller	K.L.G.	Steel	16	Oilzum	Rudge	Silvertown.	34x4	35x5	106
24	Crawford	Chandler	4	3.75	6.75	Miller	Rajah	Levett	16	Oilzum	Rudge	Nassau	32x4½	34x4½	106
25	Crawford	Lewis	4	3.75	6.75	Miller	Rajah	Levett	16	Oilzum	Rudge	Nassau	32x4½	34x4½	106
26	Crawford	Johnson	4	3.75	6.75	Miller	Rajah	Levett	16	Oilzum	Houk	Nassau	32x4½	33x4½	106
27	Premier	Rooney	4	3.66	6.656	Zenith	K.L.G.	Levett	16	Oilzum	Rudge	Silvertown.	32x4½	35x5	105
28	Premier	Anderson	4	3.66	6.656	Zenith	K.L.G.	Levett	16	Oilzum	Rudge	Silvertown.	32x4½	35x5	105
29	Premier	Wilcox	4	3.66	6.656	Zenith	K.L.G.	Levett	16	Oilzum	Rudge	Silvertown.	32x4½	35x5	105

*Six cylinders, all others are fours.
**Two carbureters.
***Two duplex carbureters giving four mixing chambers.

All cars in the race used Bosch Magnetos, Dixon's Graphite, Motometers and Hartford Shock Absorbers.

was excessive. An examination of the plugs that were used showed that they were not burnt out or destroyed but simply fouled by excessive lubricant.

Motometer readings do not indicate any overheating. It seems that racing cars are now more effectively cooled than ever before. The waterjacketing spaces on all the cars that are now racing are generous, and the seizing of pistons was very conspicuous by its absence. Of course, with the shutting off on the turns, seized pistons are not to be expected as often as at New York where there is no shutting down and the speeds range almost 20 m.p.h. faster.

Difficulty in starting means the loss of many seconds and may sometimes cause the loss of a position. The two Maxwells required vigorous efforts to crank them and the Crawford driven by Johnson lost half a lap at the very start of the race because it could not be started until five or six men pushed it. This may seem a trifling matter, but in a race where 15 sec. counted for perhaps $5,000, it may become a very important detail.

A leaky gasket on the Crawford driven by Chandler caused a considerable amount of trouble. This was replaced twice, but the tank could not be kept sealed due to some defect in the filler cap attachment. This was one of the exceptional cases where details bothered the drivers. The race was particularly free from the small troubles which generally cause a great many delays. There was more tire trouble than would have been expected in the light of the good performances in recent races, but the sun was warm and the vitrified brick of the track was hot to the touch.

A Tire-Cooler

Eddie Rickenbacher had an attachment on his car that he seemed to be a little sensitive about. At any rate, he kept it covered with a pair of overalls before starting. This was eventually discovered to be a tire-cooling attachment. In the tail a quantity of water was contained and leads were taken to each wheel ending in spray nozzles by which the water can be thrown on the tires. It is said to operate under about 4 lb. air pressure, the controlling valve being handled by the mechanic.

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England Buys Plant Site

DETROIT, MICH., May 29—The England Mfg. Co., making a specialty of pressed steel door panels for automobiles, and at present located in a factory at Jefferson and Campbell Streets, this city, has acquired a 3-acre factory site adjoining the plants of the Federal Motor Truck Co., and contemplates building a plant comprising 54,000 sq. ft. of floor-space to enlarge its business in its specialty. The plant is to be ready for occupancy in 60 days.

The Record of Pit Stops

Duesenberg—D'Alene—One stop.
Lap 52; 1 min. 35 sec.
Changed right rear tire; took on gas and oil.

Maxwell—Henderson—Four stops.
Lap 53; 1 min. 18 sec.
Rickenbacher relieved Henderson; changed right rear tire; took on gas and oil.
Lap 72; 1 min. 10 sec.
Changed right front.
Lap 82; 40 sec.
Changed right rear and took on oil.
Lap 90; 5 min. 20 sec.
Oil lead broken from oil tank.

Frontenac—A. Chevrolet—Seven stops.
Lap 7; 8 sec.
Took on water.
Lap 19; 20 min. 30 sec.
Changed plugs; took on water and oil; leaking oil.
Lap 23; 19 min. 26 sec.
Changed eight plugs; took on water and oil; tightened crankcase, poured water on the brakes; leaking oil.
Lap 29; 2 min. 20 sec.
Took on water; tightened crankcase.
Lap 33; 4 min. 13 sec.
Took on gasoline; changed plugs.
Lap 40; 20 min.
Changed plugs; took on oil; magneto trouble.
Lap 41; 48 min.
Fouled plugs; magneto trouble; took on water and oil; changed magneto.

Frontenac—G. Chevrolet—Seven stops.
Lap 41; 2 min.
Consultation; oil trouble.
Lap 42; 7 min. 20 sec.
Changed plugs.
Lap 45; 35 min.
Valve bent; changed plugs; Joe Boyers took over wheel.
Lap 53; 5 min.
Fastened under pan; instructions; water leak.
Lap 73; 1 min. 18 sec.
Arranged right front and right rear tire; took on water.
Lap 78; 12 min. 10 sec.
Oil line broken; loose steering post.
Lap 83; out.
Burned out rod.

Osteweg—Haibe—Four stops.
Lap 57; 3 min. 30 sec.
Changed both rear tires; gas and oil.
Lap 91; 2 min.
Changed right rear tire; took on gas.
Lap 98;
Broken exhaust pipe.
Lap 103; 1 min.
Changed mechanic and driver.

Peugeot—Mulford—One stop.
Lap 72; 33 sec.
Changed right rear tire; took on gas.

Ogren—Alley—Three stops.
Lap 37; 40 sec.
Exhaust pipe broken off.
Lap 55; 7 min.
Bolt in radiator stay rod; changed right front tire; water.
Lap 100; 1 min. 20 sec.
Right rear and water.

Sunbeam—Christiaens—One stop.
Lap 16; 30 sec.
Changed left rear tire.

Peugeot—Resta—One stop.
Lap 70; 1 min. 4 sec.
Changed right rear tire; took on gas.

Delage—Oldfield—Four stops.
Lap 9; 40 sec.
Changed right front tire.
Lap 40; 1 min. 19 sec.
Changed right rear tire; gas and oil.
Lap 72; 1 min.
Changed left rear tire; took on gas.
Lap 103; 23 sec.
Changed right front tire.

Peugeot—Aitken—Six stops.
Lap 18; 1 min.
Changed right rear tire.
Lap 25; 12 min.
Changed left rear tire.
Lap 50; 30 sec.
Changed right rear tire; took on gas.
Lap 66; 51 sec.
Changed right rear tire.
Lap 68; 4 min.
Oil on plugs.
Lap 69; out.
Broken valve.

Peusun—Franchi—One stop.
Lap 9; 8 min. 37 sec.
Changed plugs.

Crawford—Lewis—Five stops.
Lap 6; 2 min.
Fixed gasoline tank gasket.
Lap 24; 2 min.
Changed both rear tires; examined plugs.
Lap 58; 2 min.
Changed both rear tires.
Lap 67; 3 min.
Gas tank loose.
Lap 70; out.
Loose gas tank.

Crawford—Johnson—Six stops.
Lap 15;
Information.
Lap 16; 22 sec.
Changed left rear tire.
Lap 26; 22 sec.
Changed right rear tire.
Lap 54;
Information.
Lap 55; 2 min. 20 sec.
Changed both rear tires; adjusted brake.
Lap 90; 2 min. 20 sec.
Took on gas; adjusted carbureter.

Premier—Rooney—Two stops.
Lap 23; 5 min.
Changed plugs.
Lap 38; 12 sec.
Le Cain relieved Devigne.

Premier—Anderson—Two stops.
Lap 15; 26 min.
Changed plugs.
Lap 25; out.
Broken connecting-rod.

Premier—Wilcox—Five stops.
Lap 4; 6 min.
Changed spark plugs.
Lap 14; 4 min. 6 sec.
Changed spark plugs.
Lap 41;
Gas and water.
Lap 45; 37 sec.
Changed right rear tire.
Lap 72; 3 min. 45 sec.
Took on water, gas and oil; engine boiling.

Crawford—Chandler—Six stops.
Lap 7;
New gas tank cover.
Lap 11;
Information.
Lap 12;
Gasket on tank.
Lap 40;
Changed drivers.
Lap 71;
Changed left rear tire; took on gas.
Lap 74;
Changed plugs.

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1917 Model Six-Cylinder Grant Is $30 Higher in Price

CLEVELAND, OHIO, May 30—The Grant Motor Corp., this city, has announced its 1917 six-cylinder model which sells at $825 or $30 more than the 1916 model. The three- and five-passenger models will sell at $825, while the three-passenger cabriolet will cost $1,050.

Though the size of the motor remains the same, 3 by 4¼, several other changes have been made. The 1917 model has a Wagner two-unit starting and lighting system and Remy ignition. The valve rocker cover on the motor has been removed and the gasoline tank has been removed from the cowl to the back of the car. The Stewart vacuum feed system has been installed. The Stromberg carbureter has also been introduced.

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Best Mfg. Co. Formed

LOUISVILLE, KY., May 26—The Best Mfg. Co., this city, has been formed with a capital of $100,000 to make electrical devices for automobiles. The incorporators are G. H. Turner, A. T. Burgevin and S. S. Fitzpatrick.

A temporary plant will be rented, which will be equipped and ready for operation by June 1. Later a plant will be erected and the business conducted on a large scale.

15,000 See Races at Twin Cities

Fords, Duesenberg, Buick and Velie Share Honors in Several Events

MINNEAPOLIS, MINN., May 30—Special *Telegram*—Fifteen thousand people witnessed the Twin City speedway races to-day at Fort Snelling, the entries being amateur drivers with the exception of Lee Oldfield in an Oldfield car. The 2-mile concrete track was in fair condition. Twenty-one entries participated in the four automobile events. Time was ordinary, and the only exciting moment was when C. W. Jewett in a Jewett car, an overhauled Ford, crossed the wire 1/5 sec. ahead of C. J. Gilbert's Mercer after a neck-and-neck race for the five laps in the 10-mile handicap, which was won by M. Sorenson in a Duesenberg in 8:35 2/5. Choates in a Carnation was fourth in 10:21. The purse was $300.

Fifteen entries were made in the 50-mile race, which was run in two sections, the total purse being $2,000. A Duesenberg won in 40:56, a Mercer was second in 40:32 3/5, H. C. Feichtinger's Marquette Buick third in 41:40 2/5 and Jewett fourth in 49:41 3/5.

Jewett won the first 10-mile event in 9:33, with Clyde Mohrs, in a Buick, second. There were five entries in this event in class C, division V, non-stock up to 230 cu. in., the prizes amounting to $300.

An interesting event was a non-stock race in the same division and class, 231 to 300 cu. in., 20 miles, for $300, with four entries. This race was won by a Mercer in 17:56. J. B. Defea's Velie was second in 18:50 2/5 and R. Douglas' Corbin was third in 23:32 1/5.

The Twin City trophy race for owners and drivers of the Twin Cities was eliminated by sundown. Two motorcycle events were run, and Ruth Law in an aeroplane beat an automobile for two laps of the track.

Engine troubles were the main causes of frequent failures to finish. The cars were prepared and entered by amateur drivers and, with the exception of the Jewett, were mainly local. Mr. Jewett is State president of the retail automobile dealers, and drove himself.

Although the race lacked the glamor of world-famous drivers who took part in the initial 500-mile event last September, the attendance was as large.

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J. J. R. Features Newark Races

NEWARK, N. J., May 30—Bert Watson in a J. J. R. Special featured in to-day's automobile races at the Olympic Park ½-mile dirt track. J. W. Dickinson in a Stutz Special won the 5-mile Australian pursuit race and a 3-mile handicap event. The J. J. R. made the best time for ½ mile, negotiating the distance in 38 2/5 sec. Its time in a 3-mile event was 4:29 1/5. In another 3-miler, there was a pretty race between the J. J. R. and Dickinson's Stutz Special. The J. J. R.'s time was 3:54 2/5 and the Stutz, 3:56.

A 5-mile free-for-all was also won by the J. J. R. with Dickinson's Stutz a close second. The latter car won the Australian pursuit race in 6:37 after the J. J. R. dropped out in the fourth lap. G. T. Theobald in a Mercedes was the last to drop out of the race.

Dickinson's Stutz also won the 3-mile handicap from scratch after a close race with Theobald's Mercedes, which was in the lead until the last lap, when it was overtaken by the winner.

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Road Race for Imperial Valley

BRAWLEY, CAL., May 23—The Imperial Valley is to have a road race. A purse of approximately $5,000 has been subscribed for a race over a course which takes in the three Imperial Valley cities, Brawley, Imperial and Calexico. The length of the course is approximately 25 miles. The event is to be run under A. A. A. sanction and a representative has been sent to Los Angeles to confer with Al. G. Waddell, representative of the A. A. A. contest board in regard to the sanction and the appointment of officials as well as securing entries from Los Angeles.

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Five-Car Race for San Diego

SAN DIEGO, CAL., May 24.—Plans are under way for another race at the Exposition. The event is to be staged over the same course that Burman, Oldfield, Durant and Tetzlaff raced over in April. The A. A. A. representative has refused to allow more than five cars to start on the course and the field will be cut to the five fastest cars by elimination trials. It is planned to have the race at night, under the glare of the electric lights.

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San Fernando Plans Race

SAN FERNANDO, CAL., May 24.—The Commercial Club of this city has started on the preliminary work for an automobile race to be run over the four-mile course around the city. The event is to be a sanctioned A. A. A. contest and it is quite probable that entries will be limited to cars of 231 cu. in. and under.

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Sutterley Gets Pierce Contract

PHILADELPHIA, PA., May 29—G. T. Sutterley & Co., maker of a patented form of non-glaring headlight reflector, has closed a contract with the Pierce-Arrow Motor Car Co., Buffalo, for its device, which is now being used as standard equipment on cars of this make.

Multibestos Buys New Plant

Walpole Tire Building Taken Over—To Double Brake Lining Business

WALPOLE, MASS., May 30—The Standard Woven Fabric Co., maker of Multibestos brake lining, in order to provide additional factory facilities, has purchased the entire plant formerly operated by the Walpole Tire & Rubber Co., this city.

New equipment is being installed which will provide for at least double the present brake lining business and also allow for an expansion in the company's business in friction tape, tire tape and similar mechanical rubber goods.

For the present the plant at Framingham will be continued along with the work at Walpole, although in time it is planned to have all the manufacturing done at the local plant.

The offices and general headquarters have been removed and business from now on will be transacted at Walpole.

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New McFarlan Six at $3,200

CONNERSVILLE, IND., May 29—The McFarlan Motor Co., this city, has brought out another new "90" for the coming year. Efforts have been confined to one chassis, equipped with a six-cylinder motor, 4½ by 6. The new model is a refinement of the Series X, which has been built for several years.

New features include a longer wheelbase of 136 in., McFarlan cradle spring suspension, improved body designs, new valve setting and combustion chamber. The motor will be of the T-head type, but the spark plugs will be placed directly over the firing chamber. The tests on this motor show a high efficiency.

Artillery wood wheels, fitted with Firestone demountable rims and cord tires, are standard equipment. A sub-frame mounted on two pressed steel cross members carries the motor and gearbox.

The front axle is an L-beam with Timken bearings in the steering knuckles. The front wheels are also mounted on Timken bearings. The Timken rear axle is of the floating type. The transmission gears are mounted on Timken bearings. Worm bevel type ring and pinion are used in the differential. The steering wheel is of the tilting type, being electrically heated.

Door locks are designed for the individual bodies. The touring car lock is especially heavy, avoiding rattles and being of the convenient type. The lever handle is concealed from the outside, but carries parallel with the top door line and is in a natural position for entrance.

Factory Miscellany

Ford Buys K. C. Land—The Ford Motor Co., Kansas City, Mo., has bought a 50-ft. lot on McGee Street south of Nineteenth Street, and a 75-ft. lot on Oak Street, across the alley from the former purchase, and may improve the property at once. On the McGee Street lot—this street being one of the chief thoroughfares and a car dealers' street—a three-story building probably will be erected, with handsome display rooms on the first floor, to be used for a retail sales department. This department is now at 1710 Grand Avenue. On the Oak Street property there probably will be erected a service station, three stories, to care for the city business. The service station and plant for assembling, at Eleventh and Winchester, would then care for the business from outside the city.

The second and third floors of the two buildings will be connected by runways.

The company opened May 15 a downtown service station at 1905 McGee Street, to serve till the new building is completed.

The total expenditures, if the present plans are perfected, will probably exceed $200,000.

Jones to Move—The Jones Motor Car Co., Wichita, Kan., is moving this month into its new home in North Wichita. The present factory on West Douglas Avenue will be retained for a salesroom. The new factory covers more ground than any other manufacturing plant in the State.

The plant has a floor space of more than 100,000 sq. ft., with six spacious buildings in addition to the office buildings. The American Warehouse Co., a broom corn establishment, is vacating the buildings now and the company is moving in as quickly as possible.

New Era to Double Capacity—The New Era Engineering Co., Joliet, Ill., engaged in the manufacture of automobiles, coming here ten months ago from Detroit, has outgrown the present quarters and will shortly double the floor space. At present the company is turning out sixty-seven cars each week, but with orders on hand for 2500 it was decided to enlarge in order to double the output. Capitalization has been increased to $200,000. The new location will be on the line of the Elgin, Joliet & Eastern Railway, a half-mile east of Joliet. The officers of the New Era company are: F. J. Alvin, president and general manager; James P. Buckley, vice-president and factory manager; Winthrop Burdick, treasurer and sales manager, and W. J. Burdick, secretary and purchasing agent. The company now has a payroll of $1,000 weekly, employing sixty mechanics.

New Haynes Paint Shop—A new three-story paint shop has recently been completed at the plant of the Haynes Automobile Co., Kokomo, Ind.

New Goodyear Plant in Canada—The Goodyear Tire & Rubber Co. New Toronto, Ont., will erect one of the largest and most up-to-date plants for the manufacture of tires in Canada at the corner of Ninth Street and Lake Shore Road. The factory will be a fireproof structure and will be constructed of brick and steel. The total cost is estimated at $200,000. When the plant is in full operation it is estimated that over 300 men will be employed. The Goodyear Tire & Rubber Co. has at present one of the largest rubber plants in Canada, at Bowmanville, Ont. It was stated, however, that it is the intention of the company to use this factory solely for the manufacture of rubber heels and soles and that the proposed plant at New Toronto will be engaged in the making of automobile tires. The reason for the securing of the new site was owing to the difficulty of securing men to live and work in a town.

Ford Assembling Plant Addition for Frisco—The Ford Motor Co. will build a five-story addition to its assembling plant at Treat Avenue and Twenty-first Street, San Francisco.

To Make Automobile Locks—Steps have been taken by Marietta (Ohio) capitalists to organize a $100,000 corporation for the purpose of manufacturing automobile locks, switches and other accessories. The plan is to occupy the plant of the Galvin Manufacturing Co., located at East Norwood, near Marietta. It is proposed to call the concern the C-D Manufacturing Co. F. A. Caskey will be president and secretary; G. F. Dupree, Jr., vice-president and sales manager, and O. D. McPherson, treasurer and auditor. F. D. Kunkle will be chief engineer.

The Automobile Calendar

ASSOCIATIONS

June 12-16—S. A. E. Summer Trip on Great Lakes.

July 2-6—Detroit, Mich., World's Salesmanship Congress, Detroit Board of Commerce Bldg.

Dec. 2-9—Electricians' Country-wide Celebration.

CONTESTS

June 4—Sheepshead Bay Speedway, 30-mile Race, American Liberty Day Committee.

June 10 — Chicago Speedway Race. International 300-Mile Race, Speedway Park, Speedway Park Association.

June 20—Galesburg, Ill., Track Race, 100 miles.

June 28 — Des Moines, Iowa, Speedway Free-for-All, 300-Mile Race.

July—LaGrande, Ore., Track Race, LaGrande Motor Club.

July 4—Coeur d'Alene, Idaho, Race Meet, Hiller-Riegel Co.

July 4—Tacoma, Wash., Speedway Race, Tacoma Speedway Assn.

July 4—Minneapolis 300-Mile Speedway Race.

July 4—Sioux City Speedway Race.

July 4—Newark, N. J., Track Race, Olympic Park, Auto Racing Assn.

July 15—Omaha, Neb., Speedway Race.

July 15—North Yakima, Wash., Track Race, Hiller-Riegel Co.

Aug. 5—Tacoma Speedway Race, Tacoma Speedway Association.

Aug. 11-12—Pikes Peak, Col., Hill Climb, Pikes Peak Auto Highway Co.

Aug. 12—Portland, Ore., Track Race, Hiller-Riegel Co.

Aug. 18-19—Elgin Road Race, Chicago Auto Club.

Sept. 4—Newark, N. J., Track Race, Olympic Park, Racing Assn.

Sept. 4—Indianapolis Speedway Race.

Sept. 4—Des Moines Speedway Invitation Race. Limited to six entries.

Sept. 4-5 — Spokane, Wash., Track Race, Inland Auto Assn.

Sept. 16—Providence Speedway Race.

Sept. 29—Trenton, N. J., Inter-State Fair. H. P. Murphy, Racing Sec.

Sept. 30 — New York City, Sheepshead Bay Speedway Race.

Oct. 7—Philadelphia Speedway Race.

Oct. 7—Omaha Speedway Race.

Oct. 14 — Chicago Speedway Race.

Oct. 19—Indianapolis Ind., Race, Indianapolis Motor Speedway.

Nov. 16 and 18—Santa Monica, Cal., Vanderbilt Cup and Grand Prix Races.

GOOD ROADS

Sept. 6-7—St. Paul, Minn., Good Roads Congress, Auditorium.

MISCELLANEOUS

June 8—New York City, Orphans' Day Outing at Donnelly's Grove, College Point, L. I. Orphans' Automobile Day Outing Assn.

SHOWS

Sept. 2-9—Columbus, Ohio, Fall Show, Ohio State Fair, Columbus Automobile Show Co.

TRACTOR

July 17-21—Dallas, Tex., Tractor Demonstration.

July 24-28—Hutchinson, Kan., Tractor Demonstration.

July 31-Aug. 4—St. Louis, Mo., Tractor Demonstration.

Aug. 7-11—Fremont, Neb., Tractor Demonstration.

Aug. 14-18—Cedar Rapids, Iowa, Tractor Demonstration.

Aug. 21-25—Bloomington, Ill., Tractor Demonstration.

Aug. 28-Sept. 1—Indiana Tractor Demonstration.

Sept. 4-8—Madison, Wis., Tractor Demonstration.

Sept. 11-16 — Milwaukee, Wis., Fall Show. Wisconsin State Fair. Milwaukee Automobile Dealers.

The Week in the Industry

Trade Happenings

Northwest News—The Smith Form-a-Truck Co. has opened offices in Seattle at 316 East Pike Street. The newly-organized branch is headed by J. H. Ironsides as president, G. F. Haag, secretary and treasurer, and F. P. Kendall, sales manager.

Automobile regulations governing the admission of automobiles into the Mount Tacoma National Park state that the regulations have been revised under date of March 1, 1916, and the fees fixed at $4 for a single round trip and $6 for the season. The permissible speed has been raised from 6 m.p.h. to 8 m.p.h. Otherwise the regulations are the same as those of 1915.

The Utah-Idaho Motor Co. will hereafter handle the Maxwell output in the States of Idaho, Utah and portions of Montana and Nevada during the 1917 selling season, with headquarters in Salt Lake City. Governor William Spry of Utah, ex-Governor Gooding of Idaho and N. T. Porter of Salt Lake City are the guiding figures of the company.

The Chevrolet Motor Car Co., Seattle, Wash., has opened a new home at Tenth and Pike Streets, containing all modern garage conveniences, and will be the Chevrolet distributing center for western Washington.

The Gunn Motor Co., Tacoma, Wash., has opened at 2330 South E Street and will handle Kelly-Springfield trucks in Tacoma and southwestern Washington.

Ill. News Items—Business men of Rockford are negotiating with a Wisconsin automobile firm for the location of a $3,000,000 plant. All of the proceedings so far are under cover and no definite announcement will be made until the deal is completed. Rockford has offered the old glucose property, which has 35,000 sq. ft. of floor space and which will be added to from time to time. The president of the company which is looking for a new site has perfected an automobile engine which has some new and ingenious features which promise extensive usage. The company has two other cities in view and the one offering the strongest inducements will be selected. The representatives of the company have made two visits to Rockford and the business men here are hopeful that this city will be chosen.

H. H. Collier, Rockford, Ill., has leased the Cook Building, corner of Church and Chestnut Streets, and will shortly open a garage and sales agency. Mr. Collier will be distributor for the Studebaker line and will also operate a service station.

The Hepburn & Pope Motor Sales Co., Moline, has leased the building fronting on Fourth Avenue, near Twelfth Street, formerly operated as a garage by Hager & Rank, and will conduct a garage and sales agency. The firm is composed of George Hepburn, for 13 years with the Moline and Deere plow companies, and Henry Pope. The latter was superintendent of the Midland automobile factory in East Moline; foreman of the machine department of the Packard plant in Detroit, and later with the Hudson company. The company will be distributors for the Maxwell and Detroiter cars for Rock Island and adjacent counties.

Kansas City News—The Acton-Parke Auto Co., Kansas City, Mo., has moved its service station for Maxwells to the Velie Building, 3344 Main Street, where three floors are available. The basement will be used for machine shops, the ground floor for offices and workshop, the second floor for storage, accommodating 100 cars. Ray Worthington, formerly of the Maxwell plant, is in charge. There are facilities for handling more than 1000 cars. The Maxwell sales in April, 1916, in Kansas City, were ninety-six, and May is producing business at a rate to make about 125.

The E. S. Cowie Electric Co., Kansas City, has opened at 1238 East Douglas Avenue, Wichita, a branch house for battery and other electrical equipment service. The branch is equipped similarly to the Kansas City house. C. M. Hilt, who has been purchasing agent for the firm, is in charge. The recent rapid increase in the use of farm tractors has been an especially impelling motive for the establishment of the branch, and tractor ignition will probably be the important feature of the service. The company in Kansas City serves many automobile branch houses and dealers. It has recently installed a delivery service, to call for and return batteries and equipment.

Minneapolis Trade News—J. S. Johnson, former manager of the Winton branch, and Eddie Randall, have bought Motor Inn, a garage at 1023 Marquette Avenue, and will sell Standard cars.

The B. F. Goodrich Co. branch, and H. E. Mack & Co., representing Dodge Bros., have moved to a new building at 1221-1223 Harmon Place.

George A. Clark & Son, 227 Fifth Street N., dealers in farm implements, have added an automobile supplies department with service station for repairs and suggestions for dealers.

The Times Square Auto Co. has opened a supplies store at 1229 Hennepin Avenue.

The R. C. Smith Auto Co., 1400 Hennepin Avenue, will move to a new building at 1601 Hennepin Avenue. It handles Velie and Regal cars.

Philadelphia News Items—The Thornton-Fuller Auto Co., 2041-2043 Market Street, Philadelphia, has acquired ground between Twenty-fourth and Twenty-fifth and South and Bainbridge Streets, on which will be erected a large service building for the Dodge and Simplex automobiles.

The Gomery-Schwartz Motor Car Co., Philadelphia Hudson distributors, is accepting bids on the erection of a ten-story service building on the site of the old quarters at Broad and Cherry Streets.

Marathon Tire Changes—H. H. Replogle, formerly manager for the Marathon Tire & Rubber Co. of New York at Omaha, Neb., has been made manager of sales of the Marathon company, with headquarters at the home office at Cuyahoga Falls, Ohio.

G. R. Howell, who has been representing the Marathon Tire & Rubber Co. of New York in Iowa, has been promoted to division manager at Omaha.

C. M. Folger, Southern representative for Marathon tires, has been appointed division manager at San Francisco.

Opper Succeeds Morehead—P. T. Opper, who has been connected with the Detroit branch of the B. F. Goodrich Rubber Co. for a number of years as assistant manager, has been promoted to the position of branch manager to succeed H. J. Morehead, resigned.

Large A C Spark Plug Order—The Motor Car Equipment Co. of Boston and New York City just placed an order for 357,000 A C plugs. This is said to be the largest single order ever given for spark plugs. It tops the Beckley-Ralston order of a few weeks ago for 300,000 spark plugs.

Lyman Joins Cassidy.—H. S. Lyman has resigned as Indiana factory and jobbers' representative of the H. W. Johns-Manville Co. to represent Edward A. Cassidy, New York City.

American Body to Build—The American Body Co., Buffalo, N. Y., will build a $10,000 addition to its plant at Niagara Street.

Rutenber Adds—Work has been commenced on a new service machine shop that will employ 100 more men at the Rutenber Motor Co. factory in Marion, Ind. It will be completed in 2 or 3 weeks. The new building will be 90 by 40 ft. and will be of brick and glass. The company already employs about 700 men.

Sommers Motor to Add—The Sommers Motor Co. will build a 100 by 200-ft. machine and erecting shop addition to its lant at Bucyrus, Ohio.

Parts Co. to Build—A contract has been awarded for the construction of a one-story factory at Lakeside and Fifty-first Street, Cleveland, Ohio, for the Forest City Electric Co., Windsor Avenue, maker of electric equipment and automobile parts. The estimated cost of the plant is $25,000.

Gorton Co. to Build—The L. O. Gorton Mfg. Co., Muskegon, Mich., will erect immediately at a cost of $10,000 a plant for the manufacture of automobile parts.

New Plant for Perfex Radiator—The Perfex Radiator Co., Racine, Wis., maker of radiators for automobiles, truck and tractor engines, will erect a new plant. The main building will be 65 by 250 ft. and there will also be a warehouse and a power house.

Another Pierce-Arrow Addition—The Pierce-Arrow Motor Car Co., Buffalo, N. Y., has completed plans for another four-story addition to its plant at Elmwood and Great Arrow Avenues and the New York Central Railroad, to cost $100,000, besides the four-story addition now under construction, which will also cost $100,000.

Christopher Motor Adds—The Christopher Motor Co., Chicago, Ill., is building an addition to its plant, 50 by 100 ft., to cost $20,000.

Trippensee Body to Enlarge—The Trippensee Mfg. Co., Detroit, Mich., maker of automobile bodies, has increased its capital stock from $100,000 to $125,000, for the enlargement of its plant.

Hercules to Start Production—The Hercules Motor Mfg. Co., Canton, Ohio, will start producing around the early part of June. A new plant has been finished, costing $100,000, and the company will employ over 150 men throughout the year. The new building is two stories and 300 by 70 ft. On each floor at either side there is a continuous glass-wire window. The plant will be operated entirely by electricity.

Rives Pedal's New Distributors—The George H. Rives Mfg. Co., New York City, manufacturer of the Rives adjustable automobile pedals, has established distributors throughout the country and also in Beunos Aires, Argentina, and Montevideo and Rio Janeiro, Brazil, South America. The company's offices are in the Woolworth Building, New York City, and its factory is 171 Fulton Street, Brooklyn, N. Y.

Erickson Joins Packard Electric—J. E. Erickson has joined the sales organization of the Packard Electric Co., Warren, Ohio, and will cover the territory formerly in charge of Benjamin Smith.

Chamberlin Joins Gramm-Bernstein—C. B. Chamberlin has been appointed supervisor of purchasing by the Gramm-Bernstein Co., Lima, Ohio.

Canadian Plant News—The Canadian Regal Motor Co., Ltd., is preparing plans for a factory at Berlin, Ont., to cost $18,000.

The Acme Rubber Co., Brampton, Ont., recently incorporated, will build a factory to manufacture rubber tires, rubber goods, etc., to cost $30,000. F. D. Law, 471 Yonge Street, Toronto, is a stockholder. A by-law giving the company concessions has been passed.

The Willys-Overland, Ltd., 112 Richmond Street, West, Toronto, Ont., has been incorporated in Saskatchewan with a capital stock of $6,000,000 to manufacture automobiles, motors, etc., with headquarters at Regina.

The Begg Motor Co., 1062 Georgia Street, West, Vancouver, B. C., will build an addition to its plant to cost $15,000.

The Seymour Motor Car Co., Vancouver, B. C., has been incorporated and will take over the plant of the Begg Motor Co., at 632 Seymour Street, Vancouver. W. E. Richardson is manager.

The Perfection Tire & Motor Co., Niagara Falls, Ont., with plants at Fort Madison, Iowa, and Wabash, Ind., is carrying on negotiations with the city council. The company is contemplating the erection of a plant to manufacture automobiles, tires, etc., to cost upward of $300,000.

The Russell Motor Co., Toronto, Ont., purposes to build a new factory on 28 acres recently purchased there to house the cycle and skate business. In the past these branches of the company's activities have been handled in connection with the automobile plant at West Toronto. This has been turned over to the new Willys-Overland Co. of Canada.

Ellwood Ivins' Tube Reduces Working Hours—The Ellwood Ivins' Tube Works of Oak Lane, Philadelphia, have reduced the working hours of all employees 1 hr. each day. This applies to both day and night shifts. Its plant is running full 24 hr. This, in addition to a voluntary increase in wages of all employees a few months ago.

Ind. Plant News—The Crow Motor Car Co., Elkhart, has shipped a touring car model 30 to the French Government. If it proves satisfactory the Crow company is promised an order for 100 chassis. Recently the Crow company shipped a car to Singapore and another to Shanghai, China.

The Advance-Rumely Co., Laporte, will enter its small tractor this summer in eight tractor demonstrations in different parts of the country. One noteworthy feature of the machine is that it is reversible and can be run backward or forward with equal facility by simply turning the seat around.

The Lawndale Mfg. Co., Elkhart, has just been incorporated, with a capital stock of $75,000. Among other things the company will manufacture automobile specialties. The incorporators are A. H. Beardsley, James A. Bell and W. H. Foster. Frank R. Flynn is to be office manager.

Ind. Changes—Barney Baker, formerly general sales manager for the M. Rumely Co., has again accepted employment with the Advance-Rumely Co. and will become branch manager at Fargo, N. D.

G. H. Greiger, manager of the South Bend Cadillac agency, has been appointed general manager of the Cadillac Automobile Co. for the State of Indiana, with headquarters at Indianapolis. A building is being completed for the Cadillac company.

S. K. F. Plant Ready for Work—The new factory of the S. K. F. Ball Bearing Co. in Hartford, Conn., is practically completed and machinery set up. A large clerical force from the New York offices has come to this city. Eight Mack trucks arrived Friday evening with furniture for the offices, having been run up from New York.

Hartford Trade Items—The new sales headquarters of the United States Tire Co. in the Britton Co. Building, 121 Allyn Street, Hartford, Conn., is now ready for occupancy. Complete new office equipment has been installed.

J. H. Macdonald of the R. D. Britton Co., Velie and Allen representative, has severed his connection with that concern and joined the sales force of the A. C. Hine Co., 314 Pearl Street. For several years past he has been associated with R. D. Britton, who continues the business of the R. D. Britton Co.

Automobile row in Hartford is undergoing some material changes. Ground has just been broken by the Hartford branch of the Packard Motor Car Co. of New York for a new salesroom and service building at the corner of Park and Washington Streets. The foundation of the new three-story service building of the Fuller Storage Battery Co. on lower Church Street is completed and work will begin this week on the upper structure. The excavating for the new combined service and sales building of Russell P. Taber, Reo distributor, on lower Allyn Street, which is to have an entrance from Church Street adjacent to the Fuller property, is completed and work on the foundations will begin this week. The new three-story brick, steel and concrete service building of the

Britton company, Stearns-Knight and Federal truck representative, is almost finished. Work on the new service building for S. A. Miner, Pierce-Arrow distributor for northern Connecticut, has been resumed and possession will be taken shortly. The Pennsylvania filling station at the corner of Asylum and Hurlburt Streets has been moved a half block west, the Overland company having acquired the original site.

The business and good-will of the Hartford branch of the E. J. Todd Rubber Co. has been purchased by A. P. Gunn, formerly an officer of the company and manager of the store mentioned at 274 Trumbull Street. Business will be conducted at the same address. The firm name remains the same. A. P. Gunn has taken on the exclusive representation of Kelly-Springfield tires and is planning to install a solid tire department, together with the necessary equipment for applying these tires. Andrew P. Gunn is also conducting a store on Hartford Avenue in New Britain under the name of the Gunn Rubber Co. This establishment is being managed by his brother.

A. Kaeser has been appointed service manager of the new service station of the White Motors Co. at 22 Chapel Street.

The Palace Auto Service Co., in order to devote all time to the exploitation of Mitchell cars at 348 Trumbull Street, is disposing of a large stock of accessories. This concern was one of the first in Hartford to feature accessories.

Alterations just completed by the Ashwell Service Station, 341 Trumbull Street, provide for a larger office and a rearrangement of the oil and fuel departments. This concern has been appointed service representative of the A-K ignition devices.

Wis. Plant News—The Four Wheel Drive Automobile Co., Clintonville, Wis., manufacturing the F. W. D. truck, is preparing to build another large addition, 100 by 175 ft. Early this year ground was broken for a structure of similar size, but the capacity is still inadequate, making a second building necessary. It is reported on good authority that the company has taken over the Four Wheel Drive Tractor Co., organized at Antigo, Wis., several months ago to build quadruple drive general utility tractors, and that part of the new building is to accommodate that interest.

The Aluminum Goods Mfg. Co., Manitowac, which is building a five-story manufacturing building, 50 by 300 ft., will erect a 50 by 150-ft. shop addition as soon as possible. The demand for its goods is all out of proportion to its capacity.

A plant for the manufacture of a renewable or everlasting fuse for electric current distribution circuits will be established in Milwaukee at once by the Arrow Fuse & Mfg. Co., incorporated with $35,000 capital stock by capital identified with the Schlitz Brewing interests. The inventor is O. H. Jung, chief electrician of the Schlitz company. Heretofore fuses, when burned out, were thrown away, but Mr. Jung has found a method of easily renewing the fused wire, saving the expense of a new fuse cap and socket. The fuse will be made in all sizes and for all purposes, including motor car circuits. Production starts July 15.

The John Obenberger Forge Co., Milwaukee, organized with $100,000 capital, as noted, will specialize in motor car and engine work. A plant is being equipped at West Allis, Milwaukee County, for the production of drop forgings and forgings hammered from billets, which will be supplied to the motor car, engine and machinery trade unfinished from the dies, with the exception of crankshafts, which will be finished. John Obenberger, head of the new company, is one of the best known men in the drop forge industry of the Middle West and until recently was head of a large drop forge works in Cudahy, Milwaukee County.

Wis. Trade Happenings—The affairs of the bankrupt Milwaukee Motor Co., Milwaukee, are expected to be wound up and closed at the meeting of creditors to be held May 19. At this time the proposition of Ernst G. Miller and Elise K. John to settle claims made against them by creditors for $60,000 in cash will be discussed. The claim of the Imperial Automobile Co., Jackson, Mich., has already been settled, and it is expected that the offer to other creditors, being about 75 per cent of the claims, will be accepted.

Harry Ewing, Hartford, has leased the John Landt machine shop and is opening a public garage and repair shop, to be styled the "Square Deal Garage." Mr. Ewing was for three years a traveling service man for the Kissel Motor Car Co., Hartford, Wis.

The Grover Auto & Implement Co., Junction City, Chevrolet agent, is enlarging its repair shop and installing an oxy-acetylene welding and cutting unit.

The White Automobile Co., Milwaukee, has moved into its new salesrooms and service station at 456-458 Milwaukee Street. The representatives are Matthew C. Moore and J. W. Garbutt.

The Jonas Automobile Co., Eighth and Wells Streets, Milwaukee, representing the Cadillac, is building an addition to its big building, 40 by 70 ft., one story, to be used for extra service work.

A new garage and repair shop has been established at Monticello by Wilbert Hoesley, agent for the Maxwell, Studebaker and King. Mr. Hoesley has leased the Marty Building and is completing remodeling work.

The Milwaukee shaper, a popular machine tool in motor car and parts factories of this country, will henceforth be manufactured by the Milwaukee Shaper & Transmission Appliance Co., Milwaukee, organized with a capital stock of $75,000 by A. J. Schmitz, Robert Wild and E. J. Gross, First National Bank Building. The new company takes over the entire shaper business of the Lutter & Gies Co., 258 Lake Street, which has manufactured the tool for many years. The shaper business has grown so extensive that it was deemed advisable to organize a separate concern to handle it. The new company has leased the former plant of the Stegeman Motor Car Co. at 1148-1152 Holton Street, and is already operating. The tool will not be changed in design or name.

Arthur and Anton Zeman, Milwaukee, Wis., have established an exclusive tire repair shop at Main Street and Western Avenue, Fond du Lac. The firm will also deal in Racine tires and carry a full line of accessories.

Glen Keebler and Charles Bohls have purchased the interest of W. H. Townsend in the Townsend-Metcalf Garage Co., Reedsburg. Both have been associated with the concern for several years. A three-story addition to the garage is now under way.

The Badger Garage Co., owned by Holte & Currier, Stevens Point, has disposed of its machine shop and service station to Joseph and William Koehn, Sheboygan, who have already taken charge. Holte & Currier will retain their livery and sales agency business.

Dallas News Items—G. Newby, representing the Maxwell Automobile Co., Detroit, Mich., was in Dallas recently, negotiating for the purchase of property on which to locate a plant costing $200,000.

It is known, also, that Hart Bros., representing the Maxwell company in this section of the State, have been made the offer of a site with all the necessary advantages. The proposed site will cost $20,000, the limit specified by the Maxwell company.

Two other cities in Texas, it is said, have made overtures for this assembling plant. A definite answer is expected within a short time. The Dallas Chamber of Commerce and Manufacturers Assn. is doing all in its power to have the plant located at Dallas.

After June 15, Dallas will be made the distributing point of the Southwest for the Wilson Tire & Rubber Co., through the Dallas Chamber of Commerce and Manufacturers Assn. The Dallas branch will be the biggest the Wilson company has besides its main distributing plant at Springfield, Ill.

Robinson Joins Jones Six Co.—C. F. Robinson has connected himself with the Jones Motor Car Co., Wichita, Kan. Mr. Robinson will act in the capacity of assistant general manager.